MAY 1946

# POWER

GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

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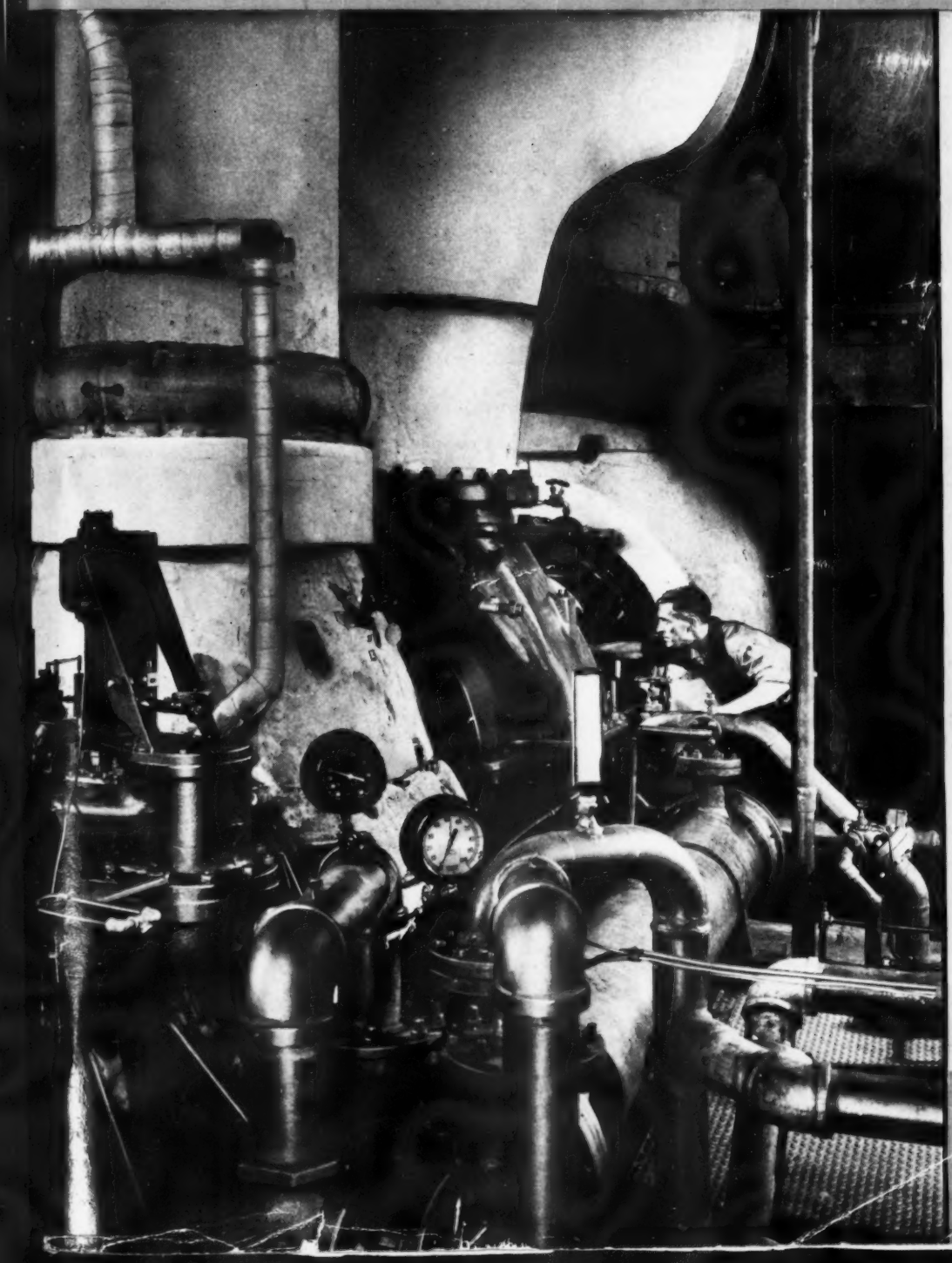
DETROIT



**Gas turbines:** Progress report on current developments presents design features of a 3500-hp 1500-F experimental installation at Annapolis and the test program expected to yield the most comprehensive data yet obtained on high-temperature operation. It also includes a summary of European work on free-piston compressor units and development of new semiclosed cycle for marine propulsion. For details turn to page 68

**Steam cost** is reduced and capacity increased by steam-generator installation in a Canadian paper mill. For the engineering reasons behind selection of boiler, firing equipment and fuel, and for a description of the plant, see article beginning on page 64

◀ *Axial-flow compressor and driving gas turbine of 1500-F Annapolis experimental unit*

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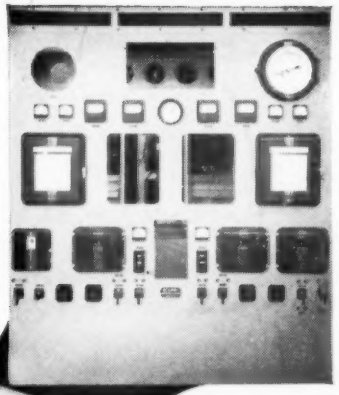
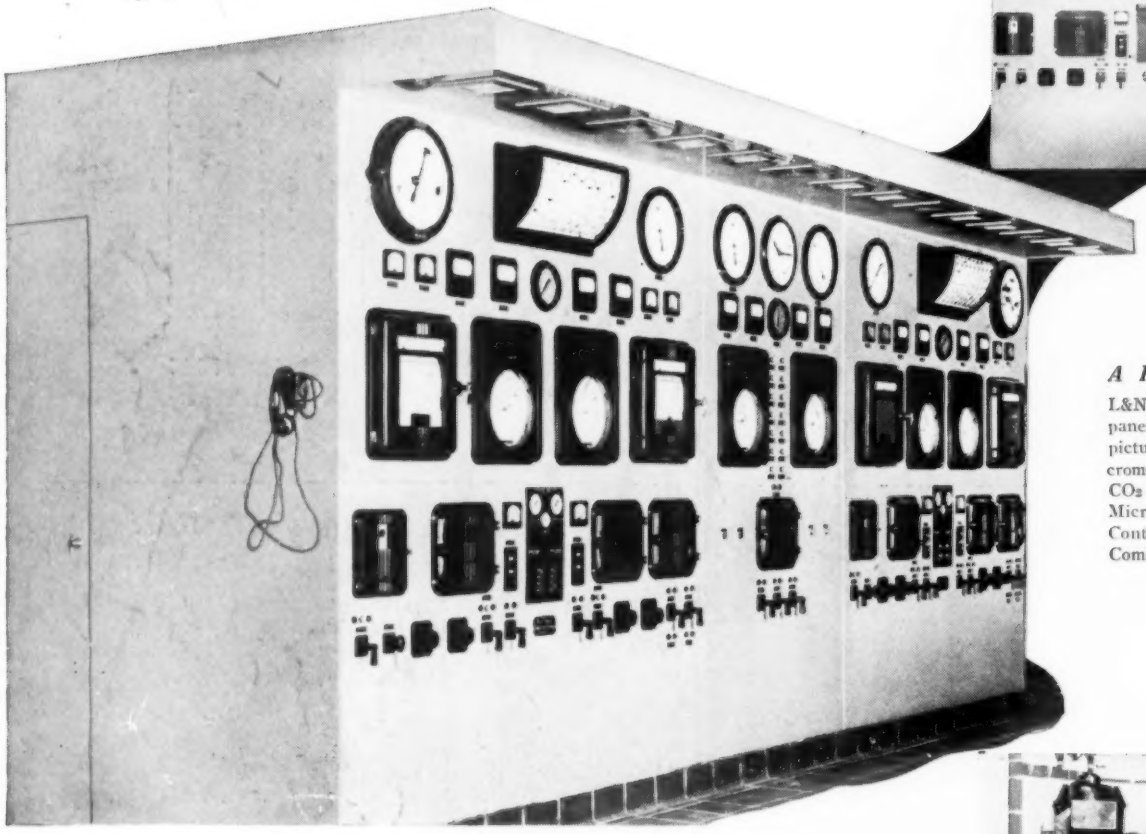
# Jennison Stations Instrumentation Shows the PLUS VALUE of L&N ENGINEERING





*A Plus Value:*

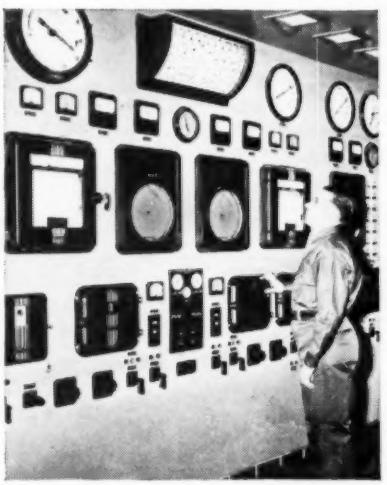
L&N equipment for one panel is shown in top picture; includes Micromax Recorders for $CO_2$ and Temperature; Micromax Superheat Control; Metermax Combustion Control.

Jennison Station of New York State Electric & Gas Corp. burns anthracite coal, on travelling grate stokers, beneath a pair of 200,000 lb/hr C. E. boilers.

When the time came to discuss boiler and turbine Control Boards for this Station, the Corporation decided, on the basis of performance, to simply duplicate the installation in another of their plants. Accordingly, Metermax Combustion Control, Micromax Superheat Control and Micromax $CO_2$ Recorders were specified. Then the entire job of engineering the boards, to accommodate L&N and all other instruments, gauges, meters, etc., was turned over to us.

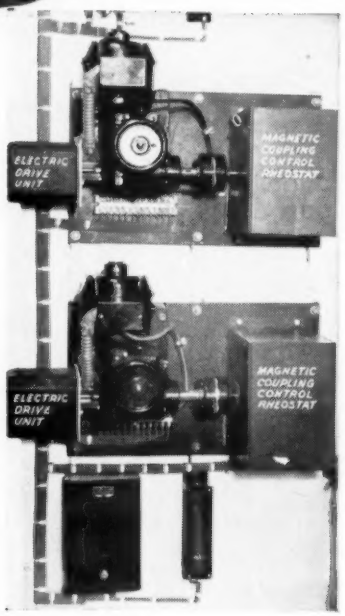
As a result, the Station saved engineering time, and installed boiler boards which experience already shows to be ideal "tools" for efficient boiler operation.

The same service which met the needs of this large Station is available for any power plant, either big or small. Just ask an L&N engineer to see you.



*A Plus Value:*

Instruments are arranged in sequence for efficient use; typical example shows operator can move a damper by Metermax Controller's built-in push button and at same time can read the draft gauge, Micromax $CO_2$ and Temperature Recorders.




*A Plus Value:*

Induced-draft Fans, and Stokers, are Metermax-Controlled from Electric Drive Units inside Cubicle through electronically-controlled magnetic couplings.

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-163(13)

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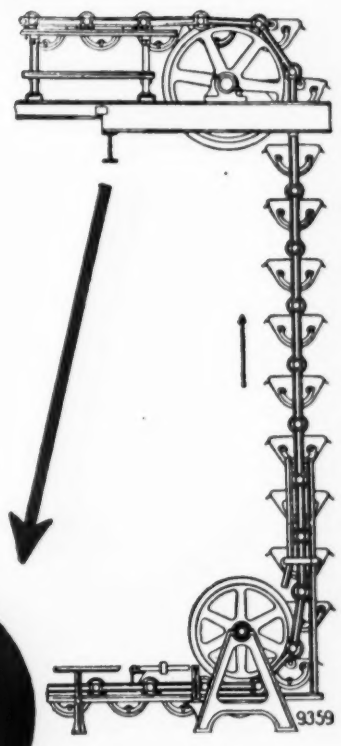
# 50 miles of PECK CARRIER hold handling costs down

MAY 13 1946

Inset shows action of automatic dumper; discharge is positive and complete.

● In its field, the Peck overlapping, pivoted-bucket carrier offers the lowest cost and most dependable type of conveying . . . proved by more than fifty miles of installations handling coal, ashes and other materials. Many Peck carrier units have been in continuous use twenty years and longer, attesting to the dependability, long life and economy of this equipment.

Since the buckets at all times maintain their carrying position by gravity, a single carrier can transport coal or ashes horizontally, vertically and again horizontally, or on any desired path. The material is *carried* in buckets, supported by rollers of large diameter in connection with two strands of specially constructed rolling chain; therefore friction and power requirements are reduced to a minimum. The material can be discharged at a number of points, merely by pre-setting the dumper which is used for engaging the cams on both sides of buckets. Each bucket rights itself to normal carrying position, and the dumping will continue automatically until moved to a new location. Can be used in cramped space. Standardization of individual units and assemblies assures interchangeability and makes possible combinations practically limitless. For details write for Book No. 1720.

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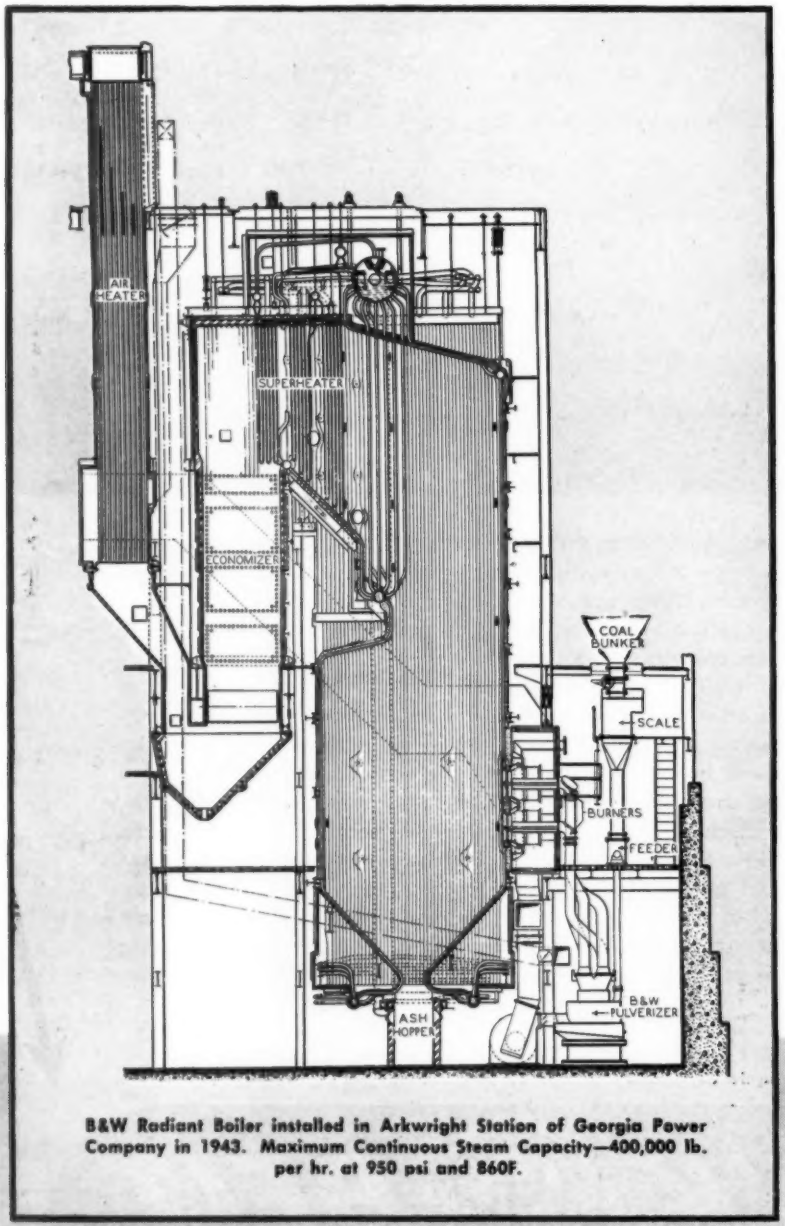
10,282

**LINK-BELT**

**COAL AND ASHES HANDLING EQUIPMENT**

# AFTER 18,000 HOURS




**B&W Radiant Boiler installed in Arkwright Station of Georgia Power Company in 1943. Maximum Continuous Steam Capacity—400,000 lb. per hr. at 950 psi and 860F.**

# INITIAL RUN...

## ...B&W BOILER TESTS "O.K."

FIRST rest in two straight years—over 80 per cent of the time on pulverized coal! More than 18,000 hours before, this B&W 400,000 lb. per hr. Radiant boiler, equipped with gas and coal burners, had started its record run in the Arkwright station of the Georgia Power Company.

When cooled down for its first inspection, the unit still held the original water, put in weeks before Tarawa and Cassino. Not a single manhole or handhole opening had been uncovered, for any reason, in all that time.

This initial inspection—first in two years revealed:

**Boiler in excellent condition:** no signs of distress or trouble of any kind.

**Superheater:** Condition excellent . . .

**Economizer:** OK . . .

**Three B&W Pulverizers:** In good shape . . .

**Georgia Power Company:** More than pleased.

While not trying to set a record, the southern utility, in its 18,000 hr. boiler run, demonstrates once again the dependability and continuity of operation built into every B&W boiler.

B&W

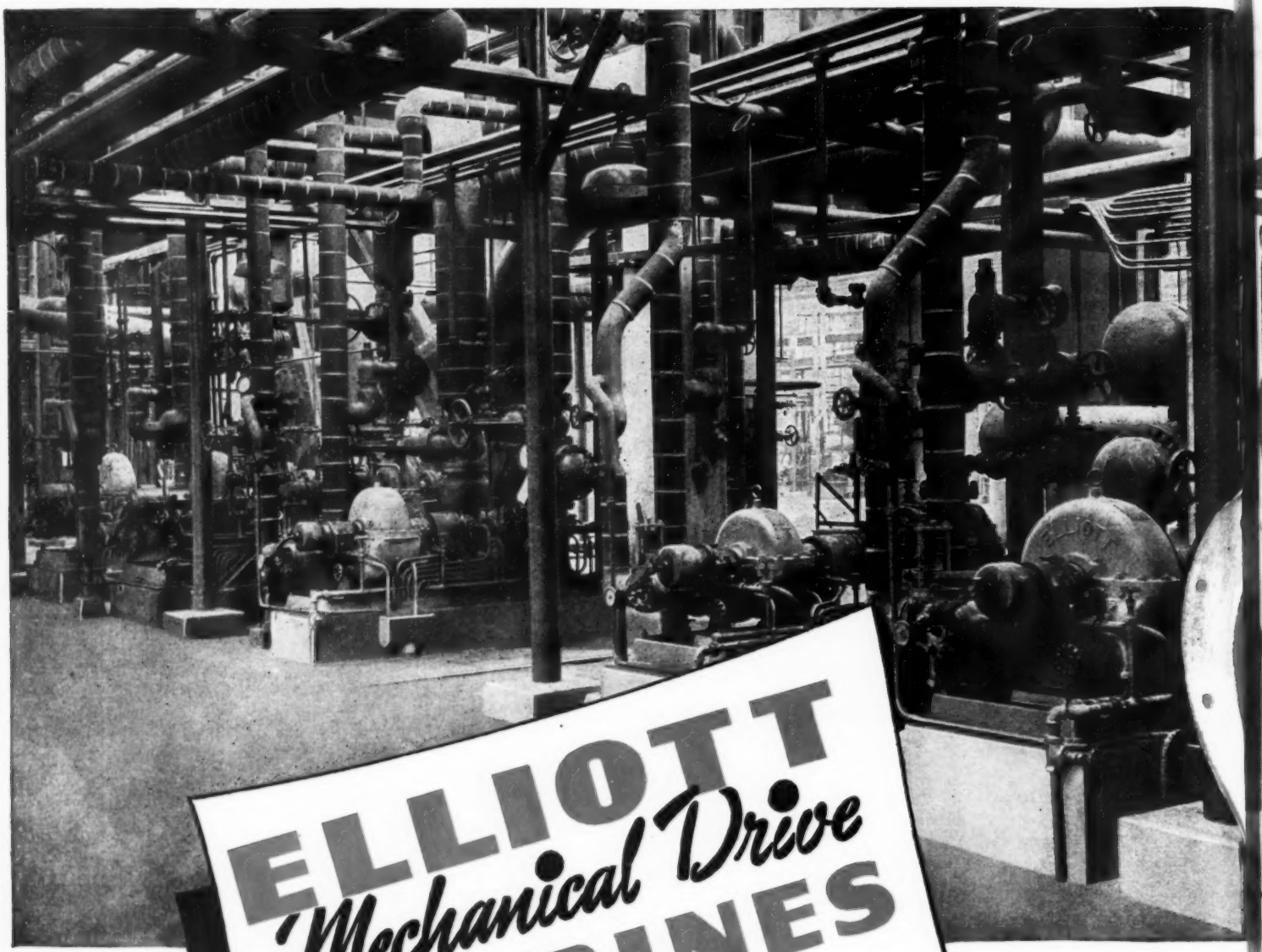
Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

**BABCOCK & WILCOX**

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.

G-323 T

# The kind of drive



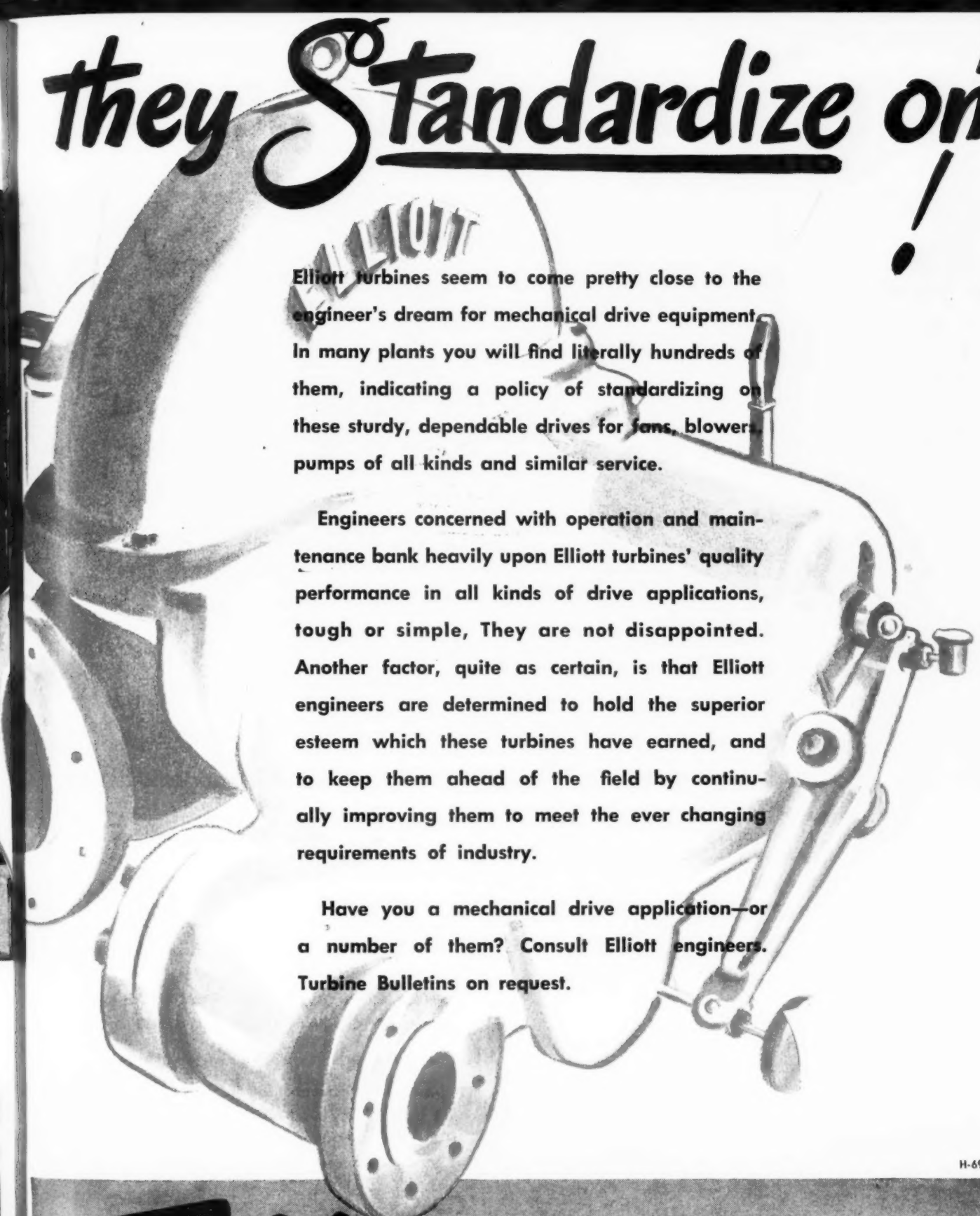
## ELLIOTT *Mechanical Drive* TURBINES

are lined up in the photo above, driving the main process pumps in a western refinery. This plant has hundreds of Elliott turbines and is one of the many plants which have standardized on tough, trouble-free Elliott turbines for responsible drives.

**ELLIOTT PRODUCTS INCLUDE**

Steam Turbines—Generators—Motors—Condensers—Feedwater Heaters and Deaerators — Steam Jet Ejectors — Centrifugal Blowers—Turbochargers for Diesel Engines—Tube Cleaners—Strainers—Desuperheaters—Filters

# they Standardize on !




Elliott turbines seem to come pretty close to the engineer's dream for mechanical drive equipment. In many plants you will find literally hundreds of them, indicating a policy of standardizing on these sturdy, dependable drives for fans, blowers, pumps of all kinds and similar service.

Engineers concerned with operation and maintenance bank heavily upon Elliott turbines' quality performance in all kinds of drive applications, tough or simple, They are not disappointed. Another factor, quite as certain, is that Elliott engineers are determined to hold the superior esteem which these turbines have earned, and to keep them ahead of the field by continually improving them to meet the ever changing requirements of industry.

Have you a mechanical drive application—or a number of them? Consult Elliott engineers. Turbine Bulletins on request.

H-698

**Elliott COMPANY**

*Steam Turbine Dept.*, JEANNETTE, PA.

*Plants at* JEANNETTE, PA.—RIDGWAY, PA.
SPRINGFIELD, O.—NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

# With DIAMOND AUTOMATIC

## JUST PUSH A BUTTON

**and the Automatic Control makes sure that all Soot Blowers operate in Proper Sequence and at the Right Speed . . . none can be overlooked. CORRECT CLEANING IS ASSURED AND BOTH FEED WATER AND LABOR ARE SAVED.**

Just push a button . . . that's all you do to clean the entire boiler, superheater, economizer, and air heater (whether soot blower elements are fixed or retracting). All blowers then operate in proper sequence and at the correct blowing speed. No blower can be overlooked or incorrectly operated by a careless operator. This automatic operation entirely eliminates the need for an attendant.

The program panel shown above controls both retracting and nonretracting blowers arranged in three groups; any desired number of groups can be had when system is designed. One "start" button controls all groups, but any group can be operated independently of other groups if desirable by simply throwing a switch on the panel. Blowing sequence of the units in any group can also be easily altered to suit changed conditions.

Compressed air has a greater density than steam and therefore provides better cleaning. The air is discharged from permanently installed elements (see bottom of right-hand page) in a series of short puffs with substantial pauses between. Spreading the cleaning cycle over a longer period of time eliminates stack discharge nuisance and permits use of a much smaller compressor.

Diamond Automatic Sequential Air Soot Blowing Systems have been in very successful central station use since 1940. For further information, write for Bulletin No. 956 which illustrates and describes an installation on a 900,000 lb/hr boiler in a modern eastern central station.

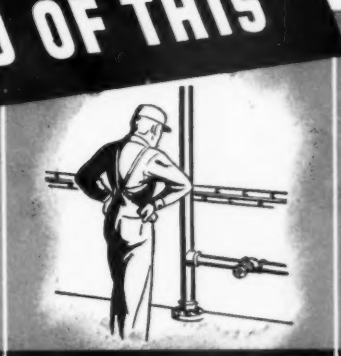
**DIAMOND POWER SPECIALTY**

*DIAMOND SPECIALTY*

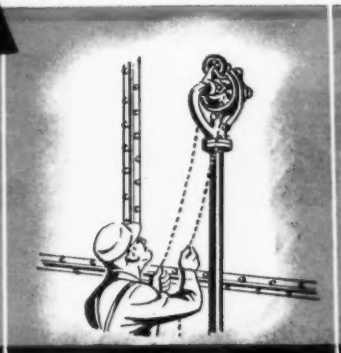
# SEQUENTIAL AIR SOOT BLOWING

## INSTEAD OF THIS

1 Opens Drain and Main Steam Valves

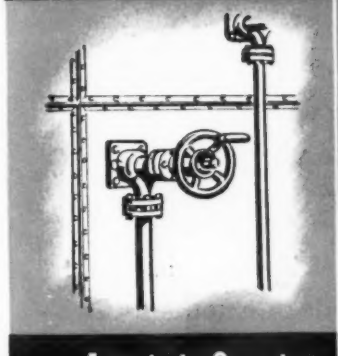


2 Drains and Warms Up Piping



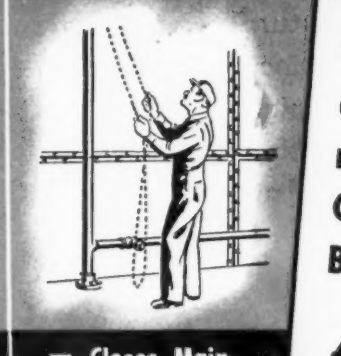
3 Operates Blower No. 1 Too Fast

4 Operates Long Retracting Blower No. 2



5 Forgets to Operate Blower No. 3

6 Operates Blowers No. 4, 5, etc.



7 Closes Main Steam Valve

**Considerable Time of an Attendant is required to Operate Conventional Soot Blowers . . . *AND THERE IS NO ASSURANCE THE WORK WILL ALWAYS BE CORRECTLY DONE!***

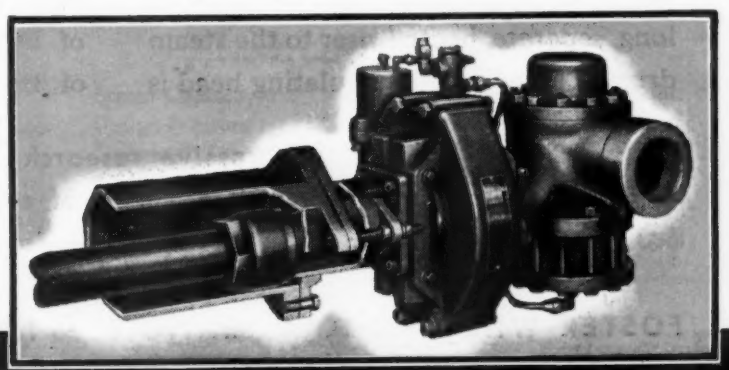
## *OTHER ADVANTAGES* of DIAMOND Automatic Sequential AIR SOOT BLOWERS

**NO FEED WATER MAKEUP**—Using compressed air instead of steam as the cleaning medium, there is no condensate loss due to soot blowing. This is particularly important where makeup water is a problem.

**SAVES FUEL**—Experience gained during several years' operation on a number of installations indicates that automatic sequential air puff soot blowing uses only ⅓ to ⅖ of the energy from the coal pile that is needed for steam blowing.

**REDUCES MAINTENANCE**—Experience on two 900,000 lb/hr boilers placed in operation in 1940 and one 900,000 lb/hr and one 550,000 lb/hr units installed in 1942 has proved the maintenance cost is unusually low.

**ELIMINATES PIPING INSULATION**—When air is used for cleaning, the soot blower piping is not insulated.



At right is the Diamond Air Puff Soot Blower having element permanently installed inside the setting; various types of retracting soot blowers are also used in the Diamond Automatic Sequential Air Soot Blower System.

**CORPORATION • DETROIT 31, MICHIGAN**

***LTD., Windsor, Ontario***

# ANOTHER USE OF

# . . . in Central Station Unit

The convection section of this public utility steam generator introduces a new application of the Foster Wheeler extended-surface natural-circulation waste heat boiler principle for central station units. The design provides convection steam generating surface in less space than the usual bare tube convection section. Further, when extensive convection surfaces are necessary, this arrangement eliminates the usual lower drum and sometimes an additional upper drum. Baffles and baffle maintenance are also eliminated.

The waste heat convection steam generating section consists of a number of parallel units, each having a small number of either bare or extended-surface elements in series. Each unit is supplied at the bottom with water from the boiler circulation, and has its own long, separate, heated riser to the steam drum. The available circulating head is very large and the circulation rate in each unit is as high, if not higher, than in the tubes of the radiant section. Gases entering the bottom of the waste heat section have been cooled in the radiant section to temperatures well below the slagging point so that the surface can be kept clean with ordinary soot blowers.

Wide experience in the design and manufacture of thousands of extended-surface elements for service under comparable—or more severe—temperature conditions in natural-circulation waste heat boilers, economizers, and superheaters, has paved the way for this new application.

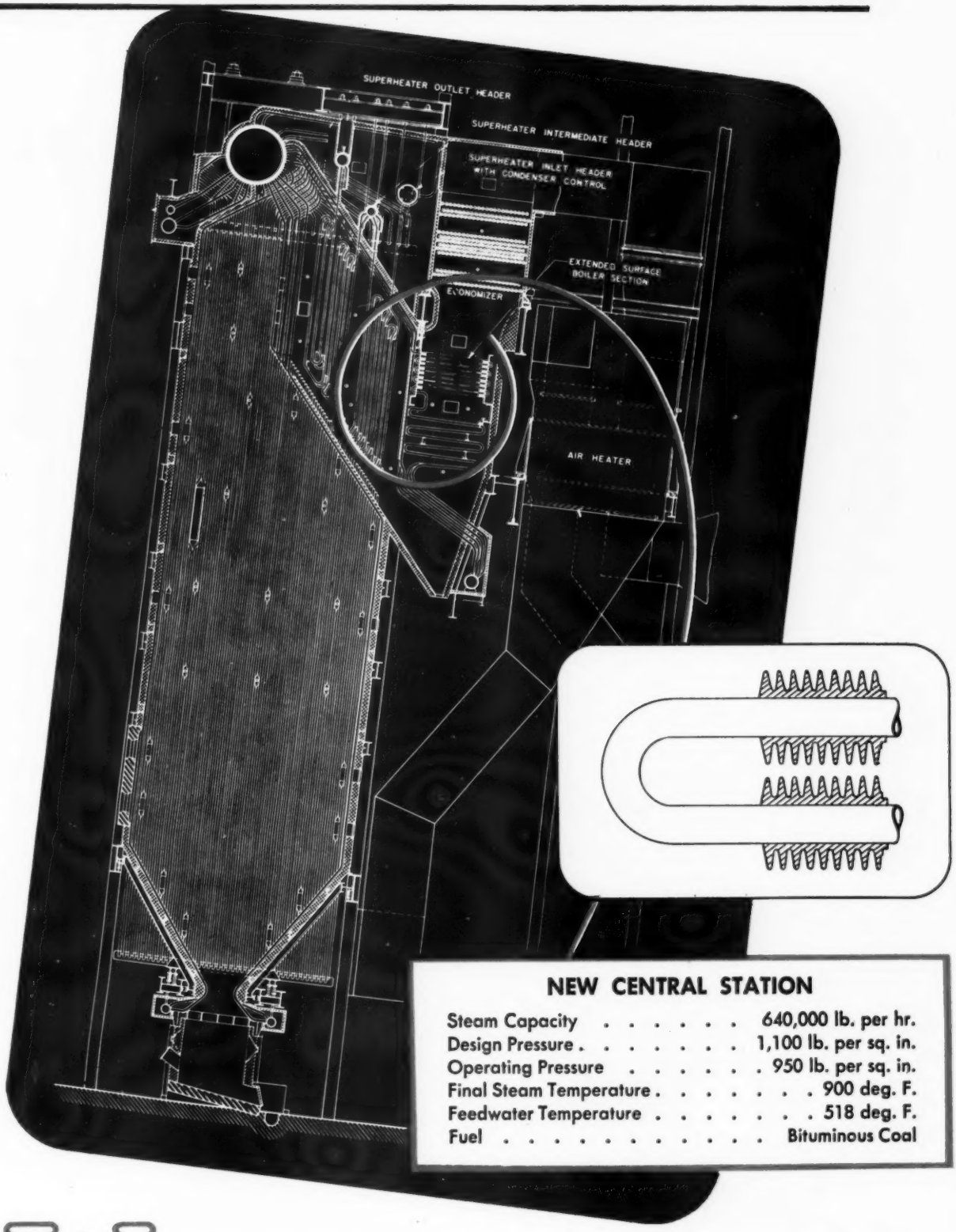
The unit will be served by two Foster Wheeler ball mill pulverizers firing bituminous coal. In addition, *eight* Foster Wheeler ball mills serve *four* boilers of other manufacture in the stations of this utility.

**Foster Wheeler progressive research and engineering have answered many difficult problems of steam generator design — bulletins describing units for varied service are available on request.**

**FOSTER WHEELER CORPORATION** • *165 Broadway, New York 6, N. Y.*

FW FOSTER

# EXTENDED SURFACE






**NEW CENTRAL STATION**

| | |
|---|---|
| Steam Capacity | 640,000 lb. per hr. |
| Design Pressure | 1,100 lb. per sq. in. |
| Operating Pressure | 950 lb. per sq. in. |
| Final Steam Temperature | 900 deg. F. |
| Feedwater Temperature | 518 deg. F. |
| Fuel | Bituminous Coal |

WHEELER FW

# HOW BAILEY CONTROLS INCREASE SAFETY

## SAFE BOILER OPERATION

### EXPLOSION HAZARDS REDUCED

**1.** Automatic Readjustment of fuel-air ratio insures proper mixture for safe efficient combustion.

**2.** Limit stops and accurate draft control protects against loss of ignition at low ratings.

**3.** Interlocks may be provided to trip out equipment upon failure of related units.

**4.** Purge interlocks insure safety in lighting-off.

### OPERATORS FREE TO ACT

In emergencies control automatically carries on leaving the operating personnel free to concentrate on the cause of the emergency.

### SAFE STEAM TEMPERATURE

Prime movers, superheaters, valves and piping are protected against excessive steam temperatures by superheat control.

### NORMAL WATER LEVEL

Damage to turbines from water carry-over and to boiler tubes from low water is avoided by effective feed water control.

### BOILER FEED PUMPS

Automatic by-pass control protects feed pumps at low rates of flow.

### IN YOUR PLANT

There may be applications where Bailey Controls will improve safety, lower fuel and maintenance costs, and enable you to render better power service.

Call on your local Bailey engineer to make recommendations or write for Bulletin 15-C which describes Bailey Controls for Steam Plants. Bailey Meter Company, 1036 Ivanhoe Road, Cleveland 10, Ohio. In Canada—Bailey Meter Company Limited, Montreal.

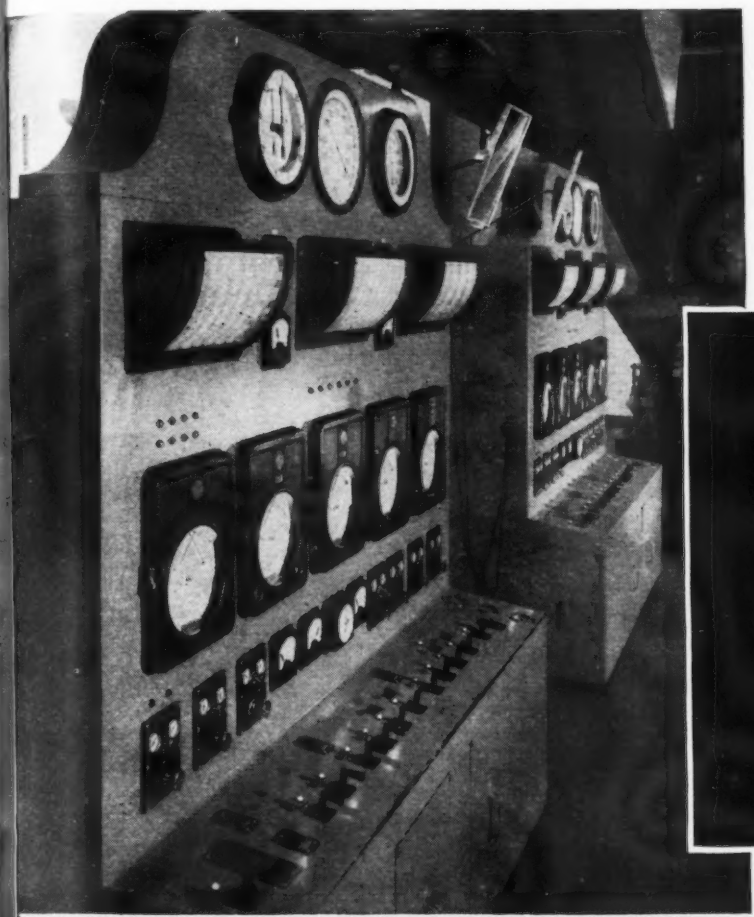
A-93

## BAILEY METER COMPANY

1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

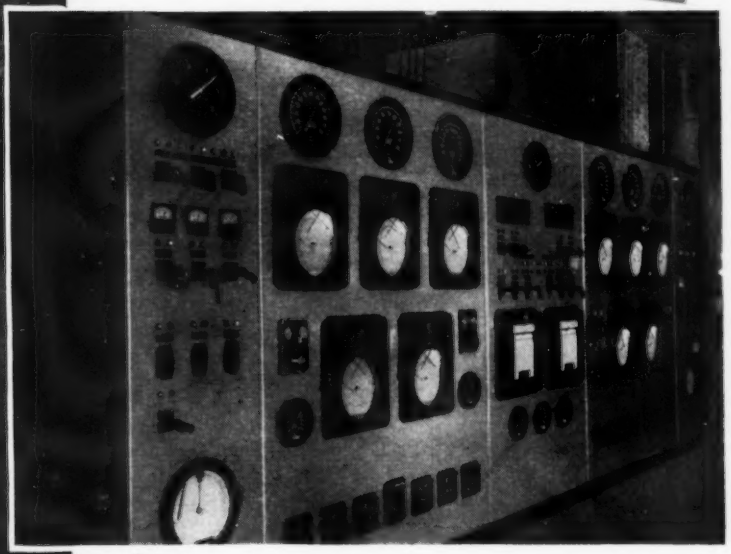
*Controls for Steam Plants*

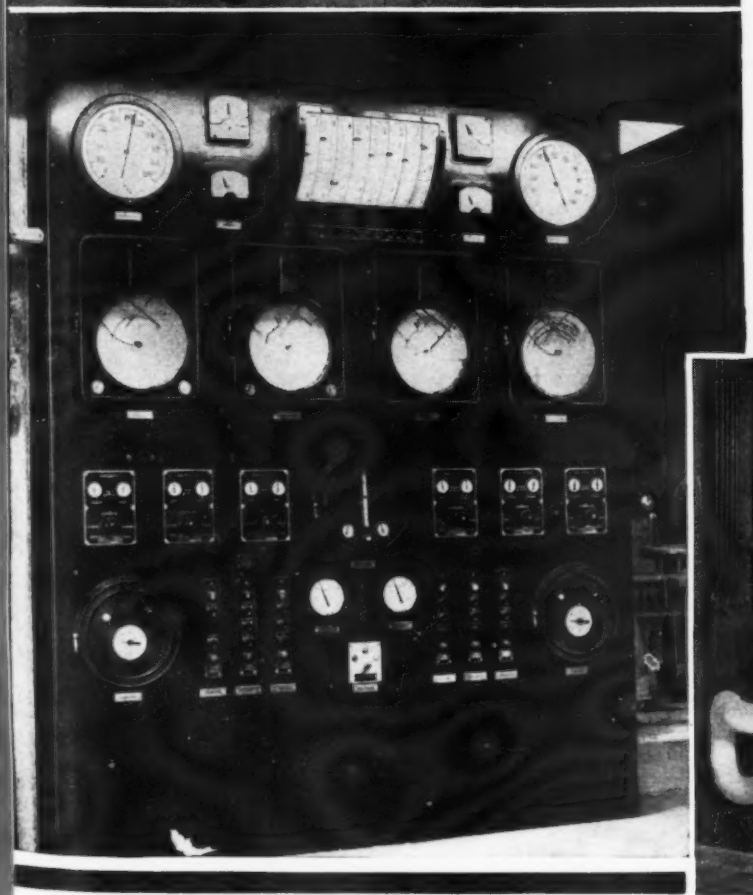
COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS



**LEFT:** Combustion Control, Three-element Feed Water Control and Superheated Steam Temperature Control for two 375,000 pound per hour pulverized coal fired boilers are coordinated on these Bailey Boiler Panels to insure safety and economy.

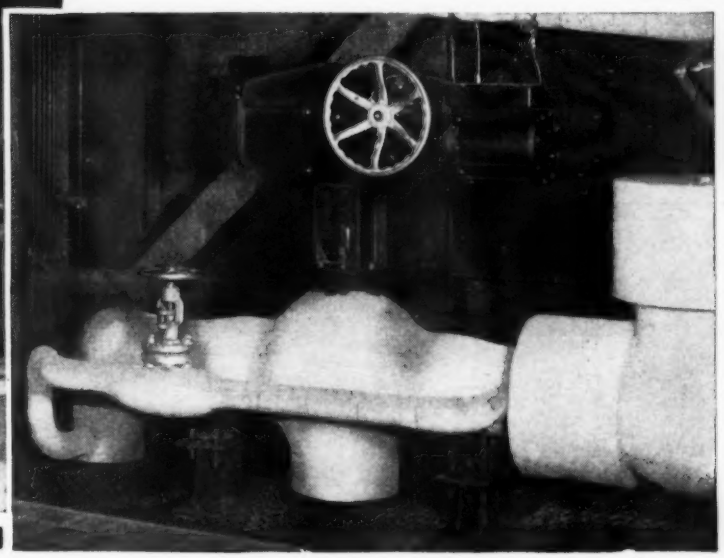
**BELOW:** Hotwell and Heater Levels in the Feed Water System for two 800,000 pound per hour pulverized coal fired boilers are automatically maintained at design values by this Bailey Pump Control Panel.





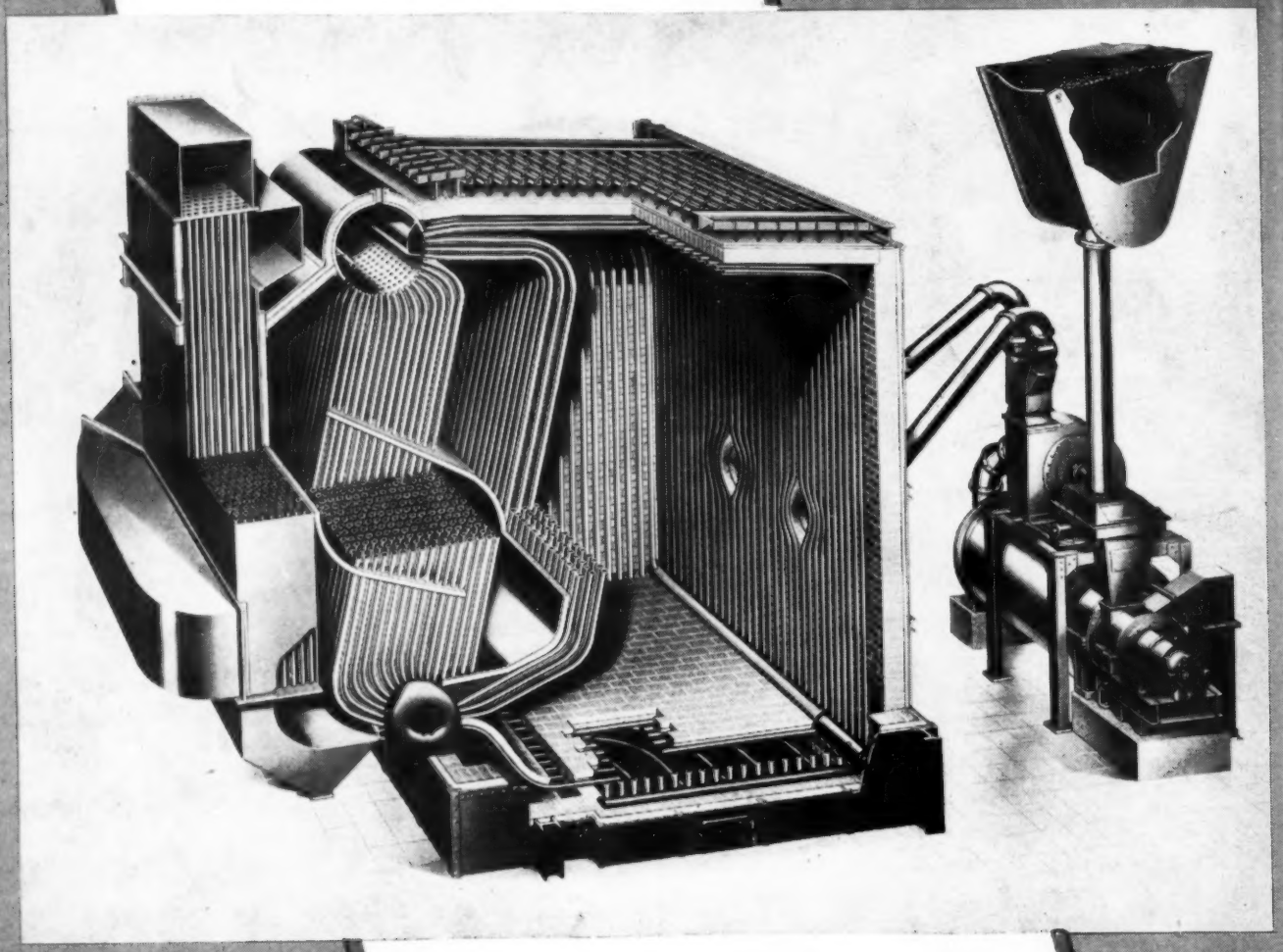
**LEFT:** This Bailey Control Panel in a synthetic rubber power plant provides for the use of waste gas as an auxiliary boiler fuel when and as it is available. Interlocks and fuel-air ratio controls insure safe operation.

**BELOW:** This 8-inch Bailey Three-element Feed Water Control Valve regulates water input to equal steam output from a 700,000 pound per hour boiler, thereby maintaining a safe water level in the drum at all times.



# KVS STEAM G

*are consistently . . . . . .*



*Specifications*

DRUMS—Fusion Welded

TUBES—Seamless Steel

FURNACE—Shadow Walls

BAFFLES—Monolithic

SETTING—Fire Brick Lined Sectionally-Supported Roof

AIR HEATER—Tubular

GENERATOR—Complete with Soot Blower, Water Column, Safety, Feed and Blow Off valves and Steam Gage

FIRING EQUIPMENT — KVS Air Swept Tube Mill, Classifier, Exhauster and Turbulent Burner

# GENERATING UNITS

## ...high in PERFORMANCE EFFICIENCIES

### 88% in Operation
### 85.3% overall with week-end shutdown

The unit referred to and illustrated here is a KVS boiler and pulverizing installation in a well-known industrial plant. It has been in operation approximately eight years. During this period, maintenance has been extremely low, additional grinding balls for the pulverizer from time to time being the major expense in spare parts.

### OPERATING DATA

Capacity . . . . . 50,000# steam per hour
Operating Pressure . . . . . 425 psi.
Fuel . . . . . Bituminous coal
Moisture in Steam . . . . . .014%
Weekly Operating Efficiency . . . . 88%
Yearly Overall Efficiency . . . . . 85.3%
with week-end shutdowns and starting periods
Guaranteed Efficiency . . . . . 87%

**Complete details of this installation designed and erected under one responsibility by KVS, will be found on pages 36-37-38, of the KVS Bulletin #44B, available on request. This unit can also be adapted to oil or gas firing.**

KENNEDY-VAN SAUN · QUALITY · SERVICE · Kennedy Products · NEW YORK USA · MFG. & ENG. CORP.

**Kennedy-Van Saun**
MANUFACTURING AND ENGINEERING CORPORATION

ARMY E NAVY

**2 PARK AVENUE • NEW YORK 16, N. Y.**

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

# GENERAL ELECTRIC Announces:

**1 to 1000 hp**

**COMPLETE ENCLOSURE**
FOR PROTECTION
AGAINST DIRT, DUST,
AND WEATHER

# NEW

## *Totally Enclosed*

## TRI/CLAD MOTORS

REG. U.S. PAT. OFF.

In 1940, G.E. introduced the Tri-Clad open motor—with emphasis on the feature that industry wanted most in a motor, *protection.* Since then, more Tri-Clads have gone into service than any other integral-horse-power motor.

Today, we are ready with a new line of Tri-Clad motors—*totally enclosed, fan-cooled motors*—built on Tri-Clad design principles in both standard and explosion-proof types.

We believe that these are industry's most dependable motors. They are designed specifically for use in many adverse atmospheres—in iron dust, outdoors, in hazardous areas, and chemical atmospheres. Their scope of application is as wide as the field of industrial motor use. Safeguarded against most sources of motor damage, their longer life and lower maintenance will make them economical motors for use on almost every job. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

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# Double Check ON

Here's an instrument that brings boiler water level indication right down to eye level, on the instrument panel or other convenient location—a perfect *check* on hard-to-see overhead gages.

Yarway's Remote Liquid Level Indicator is always accurate because it is operated by the boiler water itself—by the pressure differential between a constant head of water and the varying head in the boiler drum. Action is instant, constant, frictionless. *There are no stuffing boxes.* Indicating mechanism is never under pressure . . . it is perfectly balanced on jewelled bearings outside of the pressure chamber.

From coast to coast the Yarway Indicator is meeting with enthusiastic approval. As one prominent user said, "If I couldn't get another one like it, I wouldn't sell the one I have for many times its cost!"

More than 2,500 have already been bought for indicating boiler water level, feed heater water level, and superheater pressure differential. For complete description of operating details, write for Bulletin WG-1821.

**YARNALL-WARING COMPANY**
**100 Mermaid Ave., Philadelphia 18, Pa.**

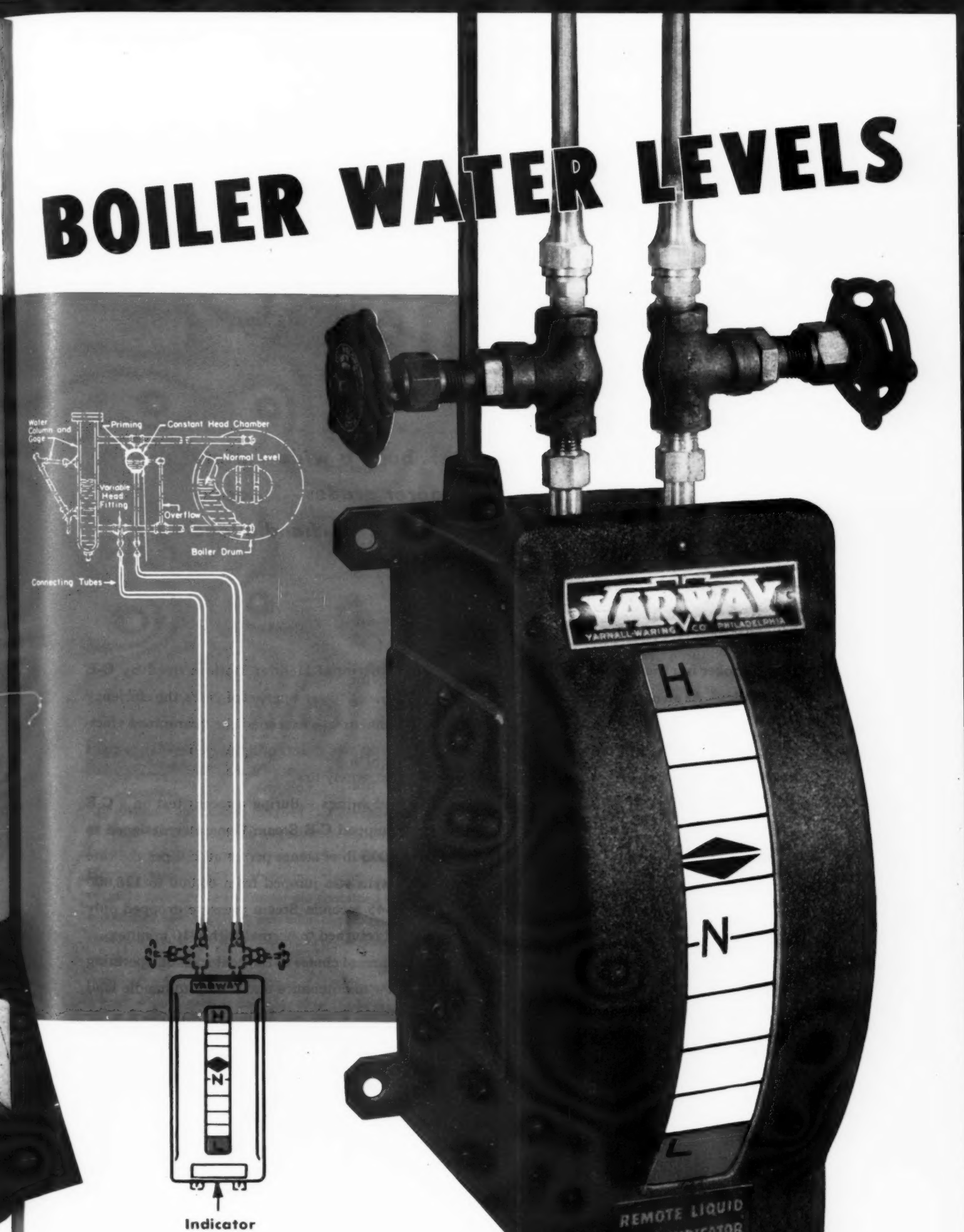
Six Yarway Remote Liquid Level Indicators flush-mounted in boiler room of large Southern textile mill.

Typical instrument panel mounting of Yarway Indicator in rubber manufacturing plant.

One of two Yarway Indicators mounted on end of instrument panel in boiler room of Western utility.

YARWAY REMOTE LIQUID

# BOILER WATER LEVELS




# LEVEL INDICATOR

# THE C-E SPREADER

***A stoker designed to— 1. burn a wide variety of coals—including the poorer grades. 2. operate efficiently and dependably. 3. handle load swings quickly and easily.***

The C-E Spreader Stoker is a "natural" for the conditions that exist these days. As an old-time operator said recently, "The best coals – you can't get 'em, but if you could, you can't afford 'em." How right he is . . . and apparently no improvement in the situation is in sight.

What to do about it? Install a stoker that will handle satisfactorily the coals that are economically available in your present day markets – and that sounds like a specification for the C-E Spreader Stoker.

C-E Spreaders are delivering that kind of service all over the country – all over the world in fact – Canada, Alaska, South America, Russia, China – and that *really* means all kinds of coal.

As for efficiency – the following is a quotation from a recent report on an installation comprising three large C-E Sectional Header Boilers fired by C-E Spreader Stokers. "Over a period of years, the efficiency of all three boilers has exceeded the guaranteed efficiency by at least two points and the maintenance costs have been extremely low."

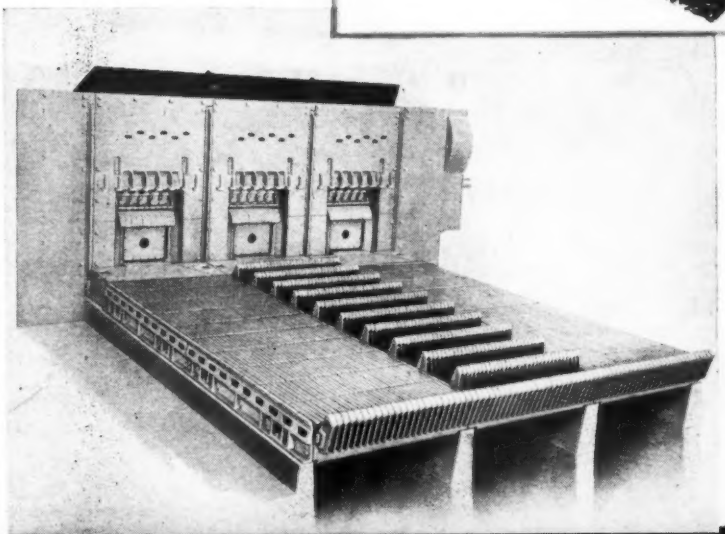
About load swings – during a recent test on a C-E Spreader-equipped C-E Steam Generator designed to deliver 115,000 lb of steam per hr at 230 psi, the rate of steam output was jumped from 60,000 to 128,000 lb per hr in 45 seconds. Steam pressure dropped only 5 lb and had returned to normal within 10 minutes.

So if freedom of choice in the coal market, operating efficiency, low maintenance and ability to handle load swings easily are important factors in your plant – the C-E Spreader is *your* stoker. A-955

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

# STOKER burns cheaper coals— EFFICIENTLY

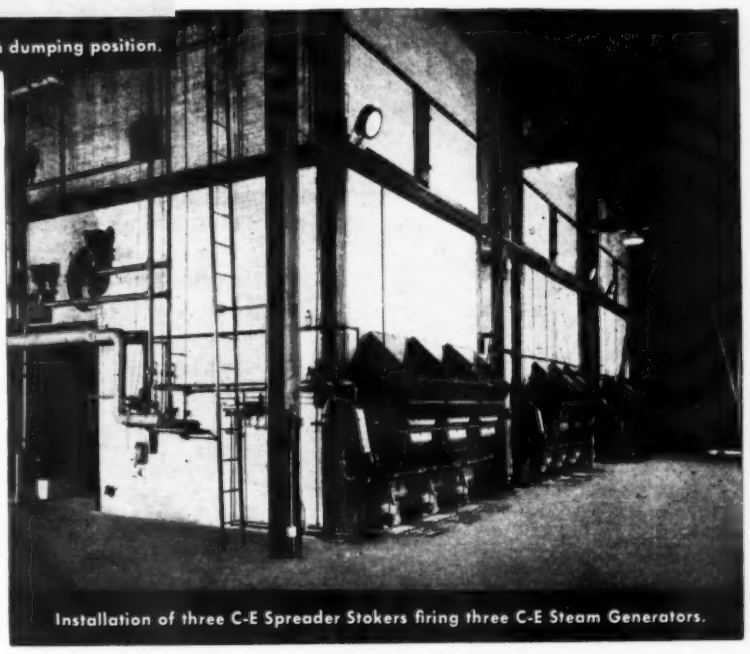


Rear view of C-E Spreader Stoker with one section of grates in dumping position.

**THE C-E SPREADER STOKER PAYS FOR ITSELF OVER AND OVER**

In an average installation the cost of coal used in a year exceeds many times the initial cost of a C-E Spreader Stoker. Moreover, the first cost of the stoker is soon absorbed by its saving in coal cost — an economy cycle that is repeated throughout its many useful years.

Approximate application range of C-E Spreader Stoker — 150 boiler hp to largest units suitable for stoker firing. Simple, rugged construction. Hopper, feeding and distributing mechanism, variable-speed drive and motor are contained in a compact unit. Rotating spreader blades feed coal into furnace in crisscrossing streams which assure uniform distribution. Fines are burned in suspension and the rest of the coal is burned on a grate — stationary or dumping type. Grate surface is zoned for regulating air admission and to facilitate cleaning. Adapted to limited space. Easy operation. Low maintenance.

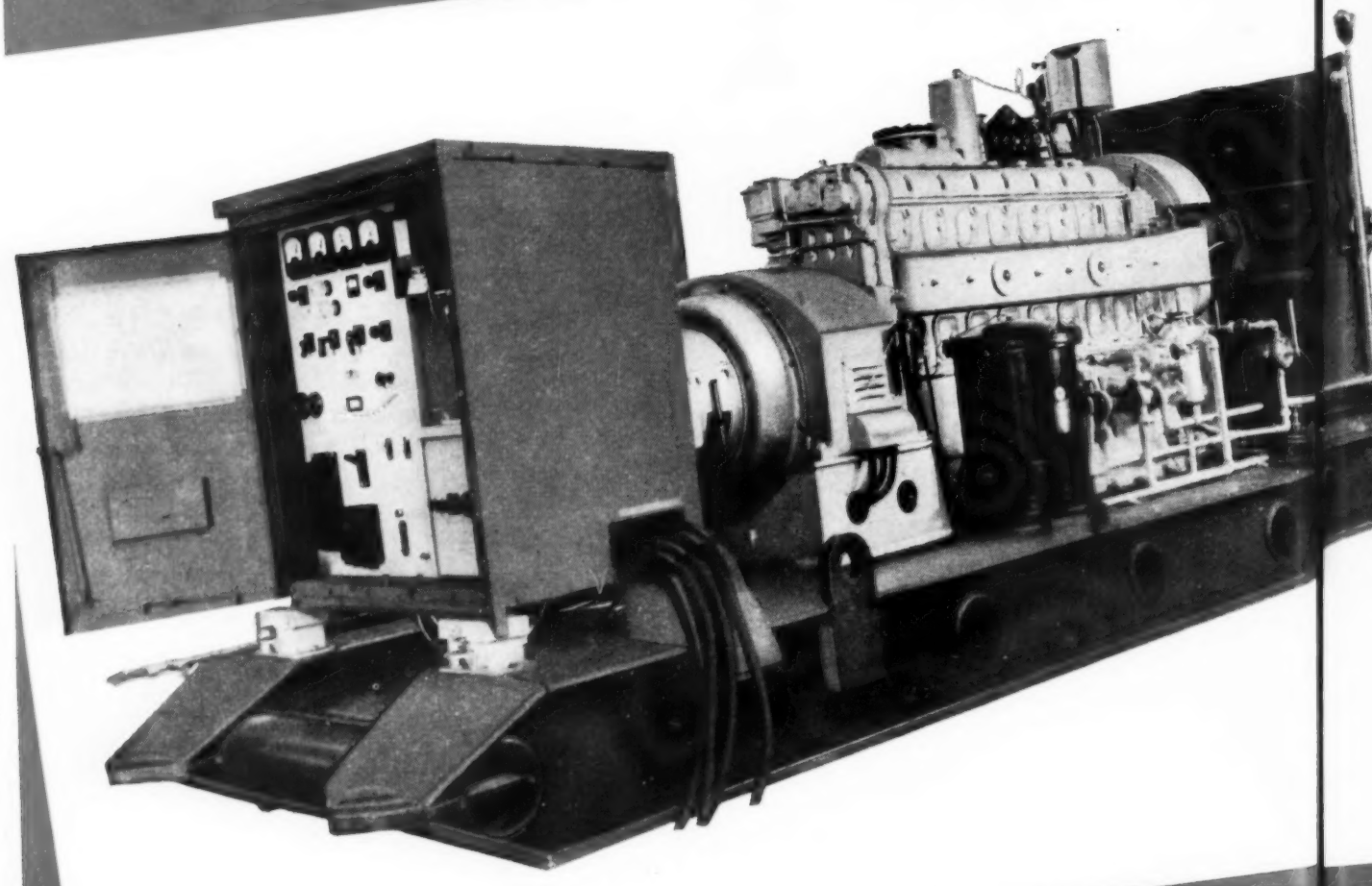


Installation of three C-E Spreader Stokers firing three C-E Steam Generators.

# ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

# Dependable E



TUNE IN THE
TEXACO STAR THEATRE
EVERY SUNDAY NIGHT
STARRING JAMES MELTON
WITH HIS GUEST, ED WYNN
—CBS

TEXACO

REG. T. M.

TEXACO

# Economical Performance

## . . . from Diesels OLD or NEW

WHETHER your Diesel is brand-new or an "old timer," it will operate more efficiently—use less fuel—when lubricated with *Texaco Ursa Oils.* These world-famous oils keep engines clean, rings free, valves active—reduce wear of bearings, rings, liners and pistons. Their use assures greater power, fewer overhauls and repairs.

*Texaco Ursa Oils* have kept pace with improvement in Diesel engine design over the past 30 years. They come in every grade necessary to assure effective lubrication of every size and type of Diesel. Because of the many benefits they deliver, *Ursa Oils* are approved by all leading Diesel engine manufacturers, and used by thousands of operators everywhere. In fact . . .

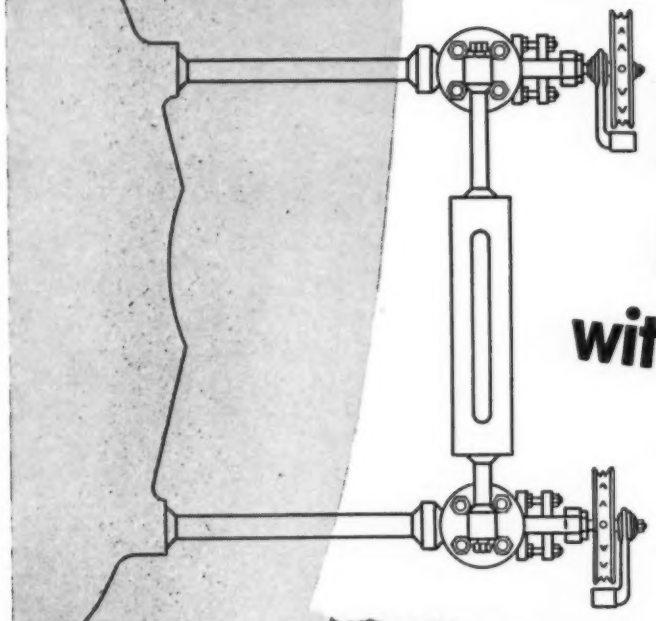
*More stationary Diesel h.p. in the U. S. is lubricated with Texaco than with any other brand.*

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

**URSA OILS**

FOR ALL DIESEL ENGINES

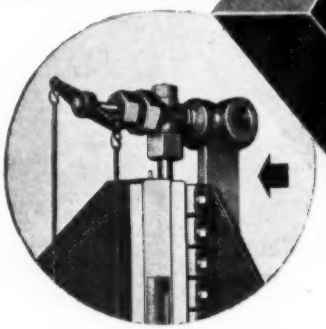
# FOR YOUR DIRECT-TO-BOILER GAGES



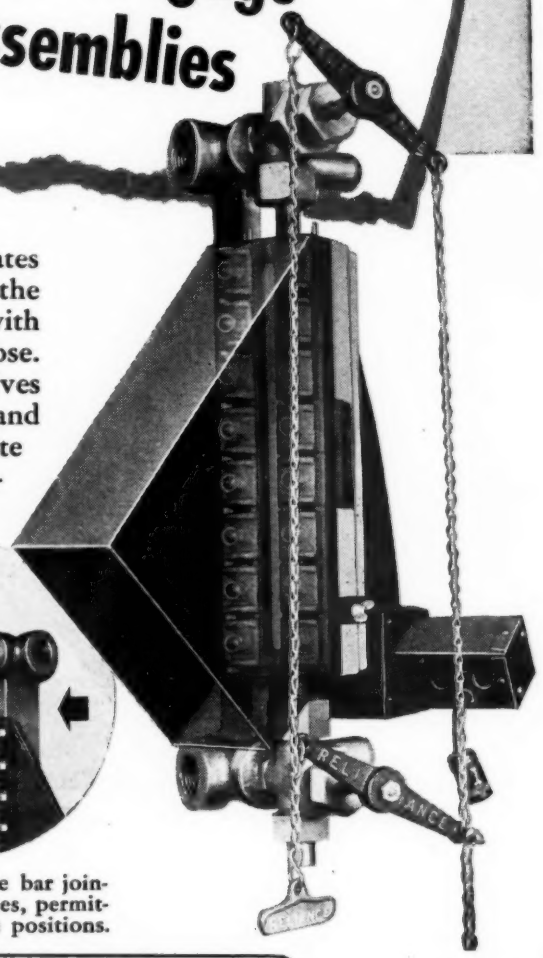
## Reliance is ready, as usual with sturdy, all-welded complete gage assemblies

Where high pressure boiler arrangement dictates the use of water gages connected direct to the drum, you're wise to plan for the greatest safety with gage equipment correctly engineered for the purpose. A Reliance completely welded assembly, with valves firmly spaced by a welded bar connecting lower and upper crosses, makes a substantial unit for moderate pressures. Assembly illustrated (right) is for pressures up to 600 lbs. Reliance Water Gages are available also for pressures to 2000 lbs., in extra-heavy design, with welding necks and flange connections welded to insert nipples. These super duty units are individually engineered to meet your specific requirements.

When new techniques are added to boiler gage practice . . . Reliance is foremost in meeting them with technically correct applications. Write for information.



Note heavy steel tie bar joining mounting crosses, permitting three alternate positions.



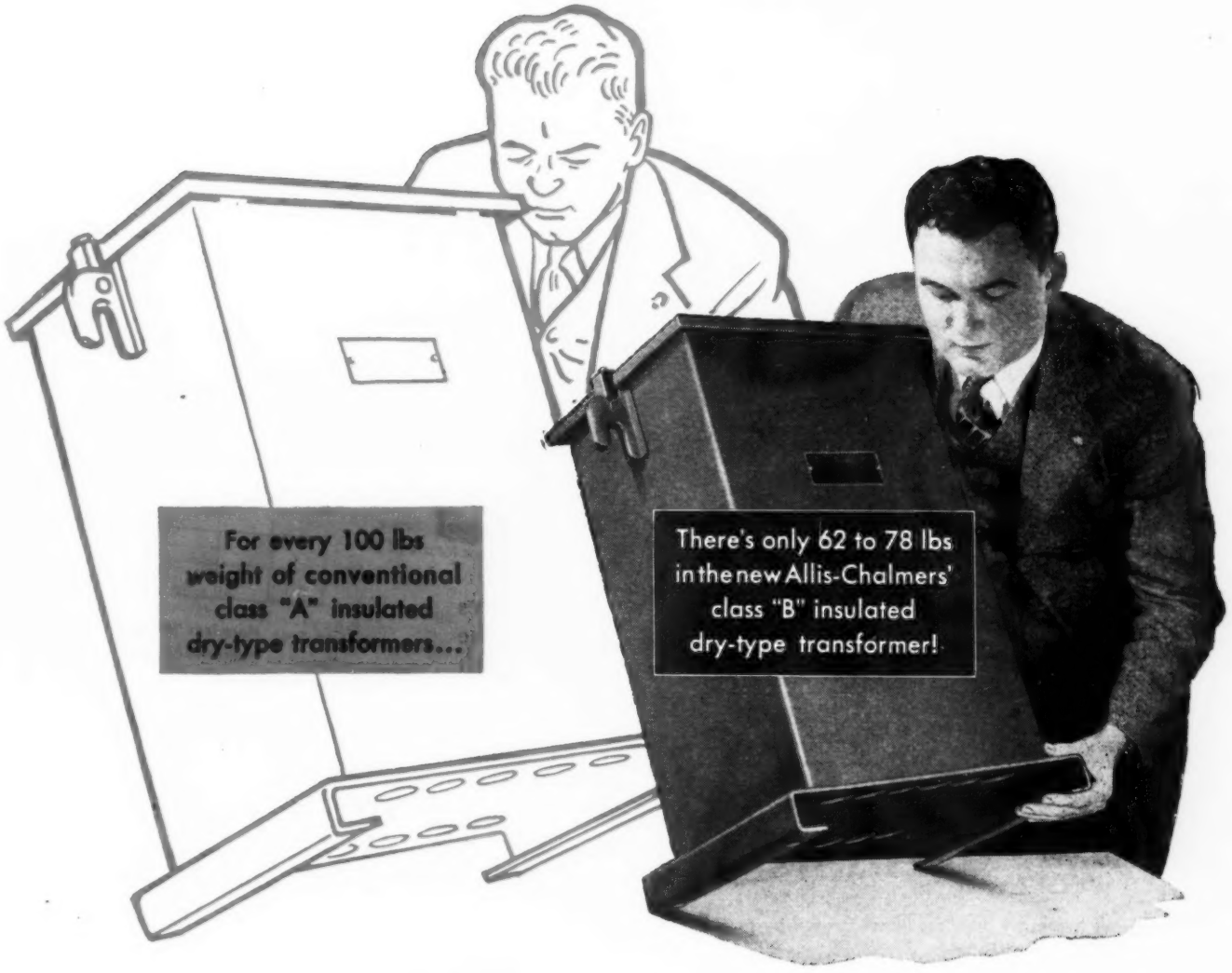
BOILER SAFETY DEVICES since 1884

**Reliance**

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

# Save 22 to 38% Weight

## WITH ALLIS-CHALMERS NEW DRY-TYPE TRANSFORMERS!


For every 100 lbs weight of conventional class "A" insulated dry-type transformers...
There's only 62 to 78 lbs in the new Allis-Chalmers' class "B" insulated dry-type transformer!

### THIS REDUCED WEIGHT HELPS YOU TWO WAYS:

It means wider range of installation . . . you can put these handy units almost anywhere you need secondary power — even on or next to machines!

It cuts down installation cost . . . you use less mounting materials—save runs of heavy secondary copper by placing these lighter units closer to load centers.

For complete details, get in touch with your nearest Allis-Chalmers dealer or sales office, or send for new descriptive bulletin B6382.

### CLASS "B" INSULATION MEANS OTHER ADVANTAGES, TOO...

*Saves Space* — reduces overall dimensions as much as 1/3 compared with class "A" insulated types.

*Safer Installation* — no combustible materials, no insulating liquids . . . thus, no fireproof vaults needed!

*Longer-Life* — resists higher temperature and protects against moisture.

*Savings* — 14 sizes ranging from 1½ to 300 kva, *cost no more* than class "A" insulated units. A 2015

**HEAR THE BOSTON "POPS":** *Every Saturday Evening, American Broadcasting Co.*

**ALLIS AC CHALMERS** DRY-TYPE TRANSFORMERS

# FUSETRONS

## —Prevent Needless Shutdowns,

### Here's Why

Fusetrons have a tremendous time-lag—far greater than ordinary fuses—due to the combining of a fuse and a thermal cutout.

Here's how time-lag of Fusetrons compares with that of ordinary fuses.

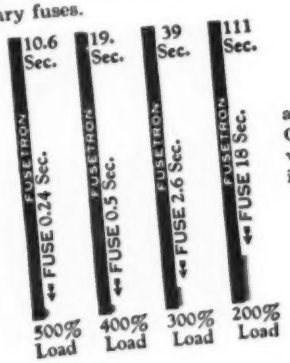


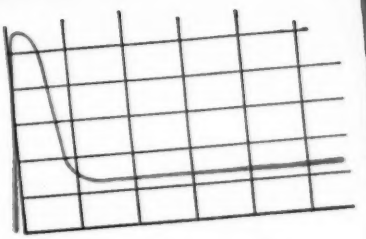

Chart shows 30 amp. 250 volt fuses. Other sizes and 600 volt ratings show similar results.

The great time-lag of Fusetrons permits them to hold harmless overloads and keep circuits in operation instead of opening and causing useless shutdowns.

Ordinary fuses or other forms of protective devices *cannot* do this job.

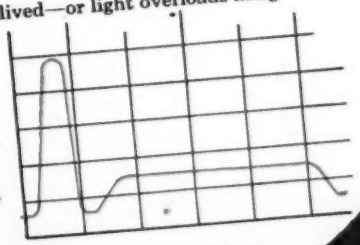
FOR EXAMPLE

AC motors require a current of 3 to 9 times their rating for starting. This high starting current often causes ordinary fuses to open.



**Fusetrons Have the Capacity to Absorb This High Starting Current Without Opening**—even where type of load causes starting current to hang on.

In normal operation overloads often occur that are heavy but short lived—or light overloads hang on. In either instance they are harmless—yet they often cause ordinary fuses or other forms of protective devices to open.



**Fusetrons Will Hold Such Harmless Overloads —and Keep the Circuit in Operation.**

LIKEWISE

## • • INSTALL FUSETRONS THROUGHOUT THE PLANT TO GET

★ ***Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.***

(*See above*)

★ ***Give Thermal Protection to Panelboards and Switches***

The thermal cutout in the Fusetron will open whenever its temperature reaches 280° F. Thus if poor contact heat develops from any cause the Fusetron cuts off the current before damaging temperatures can be reached.

Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.

With Fusetrons you are warned that a minor maintenance job is needed instead of having panel or switch damaged or destroyed by poor contact.

★ ***Prevent Needless Blows Caused by Heating in Panels and Switches***

Ordinary fuses have 55 to 140% greater electrical resistance at full load than Fusetrons, hence Fusetrons produce less heat and thus eliminate useless shutdown troubles caused by fuses running too hot in panelboards and switches.

★ ***Permit Use of Larger Motor or Adding More Motors on Circuit WITHOUT Installing Larger Switch or Panel***

The operating load on Fusetrons can be close to their ampere rating because Fusetrons hold starting currents. But ordinary fuses must be installed oversize because they lack sufficient time-lag to hold starting currents.

By replacing oversize fuses with Fusetrons, you can load panels or switches to near capacity. A large motor or additional motors can be installed without the trouble or expense of changing the panel or switch.

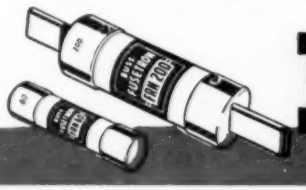
★ ***On New Installations PROPER Size Switches and Panels Can Be Used Instead of OVERSIZE***

With ordinary fuses, switches and panels must be oversize because fuses larger than the operating load must be used to hold starting currents.

But Fusetrons hold starting currents, therefore, PROPER size switches and panels to fit the load can be installed, saving money and space.

★ ***Protect motors against burnout***

On normal installations, Fusetrons used in a size near ampere rating of motor will protect it against burnout from lack of oil, worn bearings, tight belt or anything that causes a dangerous electrical overload—yet their tremendous time-lag keeps them from blowing on motor-starting current.

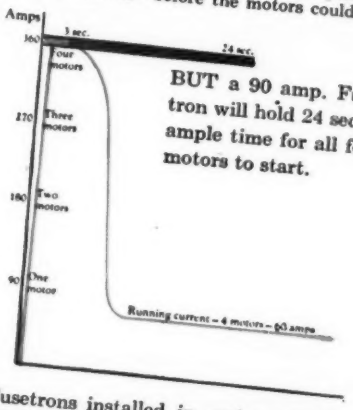


**BUSS**

# Hold Harmless Overloads
## *without Sacrificing Protection*

This tremendous time-lag will also prevent needless blows on MAINS AND FEEDER CIRCUITS. Even if all motors on the circuit start at one time—Fusetrons will not open. For example: four 15 ampere motors on a circuit would ordinarily be protected by 90 ampere fuses.

If these four motors start at one time and the starting current of each motor is 90 amperes, the combined starting current is 360 amperes. At this load a 90 ampere fuse would open in about 3 seconds—before the motors could start




BUT a 90 amp. Fusetron will hold 24 sec.—ample time for all four motors to start.

**SO** with Fusetrons installed in mains, feeders and all branch circuits—shutdowns caused by the needless opening of fuses or other forms of protective devices on motor starting currents or other harmless overloads are *entirely wiped out.*

HERE'S PROOF

**"Fusetrons Saved Us a Lot of Money and Trouble on Our Crusher Circuit"**—*Paul G. Nunn, Manager, The Nunn Company, Overton, Nevada.*

Mr. Nunn continues, "In April, 1942, we installed a crusher powered by a 40 h. p. motor. Ordinary fuses were installed. We had trouble from the beginning as the fuses would blow out almost as fast as we could put them in. We were advised that the motor was too small and it was recommended that a 60 h. p. motor be installed. The cost of the new motor and larger feeders we were told would amount to about $2,000.00.

"We were about to go ahead, however, as the shutdowns were costing us about $20.00 per day in labor alone not to speak of loss in production.

"My brother, however, sent us a set of Fusetrons and suggested we try them out. We did. Much to my surprise when the power was thrown on the Fusetrons held. This was nearly two years ago and we have not had a Fusetron blow.

"I feel that you should know that Fusetrons saved us a lot of money and a lot of trouble. We are changing over to Fusetrons throughout our plant."

## MANY KINDS OF PROTECTION HERETOFORE NOT AVAILABLE

★ ***Give DOUBLE burnout protection to large motors***

Larger motors already equipped with overload protection sometimes burn out due to thermals or relays failing to operate. Replace fuses used for short-circuit protection with Fusetrons of size near motor rating and they will protect motor against burnout from any electrical overload, entirely independent of other overload device.

★ ***Provide simplest way to stop burnouts from single phasing***

When single phasing occurs, increased current flowing through remaining phase will open Fusetrons (if size used is near the rating of the motor) and shut down motor. Never before has such dependable single phasing protection been available.

★ ***Make burnout protection of SMALL motors simple and inexpensive***

Small motors have generally been operated without burnout protection because the cost of protecting them has been too great compared to cost of replacing motor. Now for the little cost of installing a Fusetron of proper size, any motor can be given safe, dependable burnout protection.

★ ***Protect Coils, Transformers and Solenoids against burnout***

Install a proper size Fusetron. It won't open on harmless overloads or normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

## Get All the Facts

★ ***GET BETTER PROTECTION—SEND THE COUPON NOW***

Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses, change over the whole plant to Fusetrons.

BUSSMANN MFG. CO., University at Jefferson • St. Louis 7, Mo.
*Division McGraw Electric Co.*

# FUSETRONS

SOLD THROUGH WHOLESALERS

546

BUSSMANN MFG. Co., University at Jefferson
St. Louis 7, Mo. (*Division McGraw Electric Co.*)
Please send me complete facts about BUSS Fusetrons.

Name_____
Title_____
Company_____
Address_____ State_____
City_____ P546

# INSTRUMENTS ARE Bloodhounds

## FOR TRACKING DOWN POWER LOSSES THAT HAMPER PRODUCTION

★

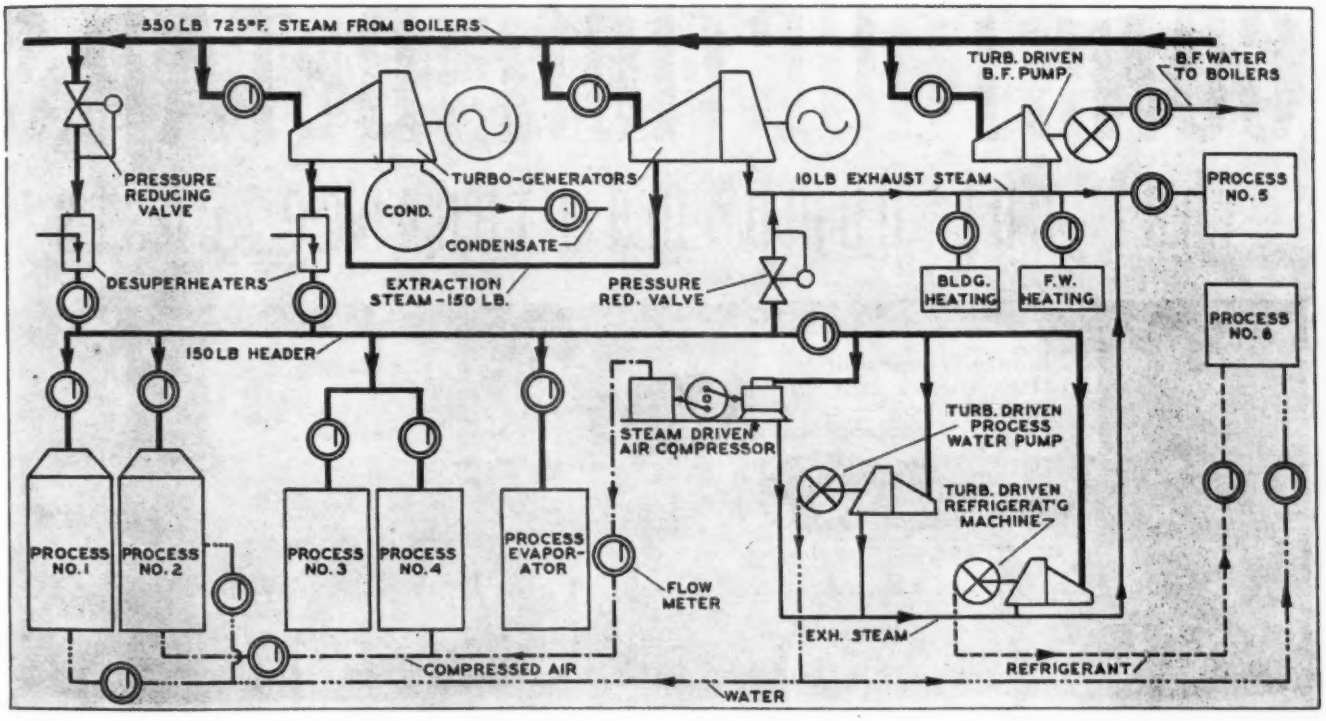
To meet your increased steam demand, you are stretching the capacity of your boilers through shrewd operation—you are generating 11 lbs. of steam for every pound of coal you burn. Great!

But how much are you gaining if the rest of your plant wastes the steam?

All the effort and engineering skill you are expending to stretch your boiler capacity to meet present emergency conditions can be nullified by wasteful use of the steam produced.

Instruments are the bloodhounds that track down these steam losses. Anything that *reduces* the power

REPUBLIC
INSTRUMENTS
AND CONTROLS




consumption of pumps, compressors, dryers or other steam consuming units *increases* the *effective* capacity of your power plant.

The only accurate and reliable check on the use and abuse of steam, water, compressed air and other power plant services is to install flow meters (and, when needed, pressure and temperature recorders) on the supply lines to the various power consuming units. Only through an instrument installation of this type can operator and department head alike be provided with the data that will enable them to immediately locate and correct faulty or wasteful operating conditions.

## MEASURING VERSUS GUESSING

The accompanying diagram shows a typical distribution meter system that provides a continuous picture of the consumption of power plant services by departments and processes, individually and collectively.

Total amount of steam consumed by prime movers and auxiliaries is measured, as well as the amounts supplied by extraction and exhaust to the various pressure systems serving process and heating loads. Actual consumption of steam, water, compressed air and refrigerant by individual departments, and even individual processes, is accurately and continuously metered instead of being merely estimated.

## SPOTTING THE LOSSES

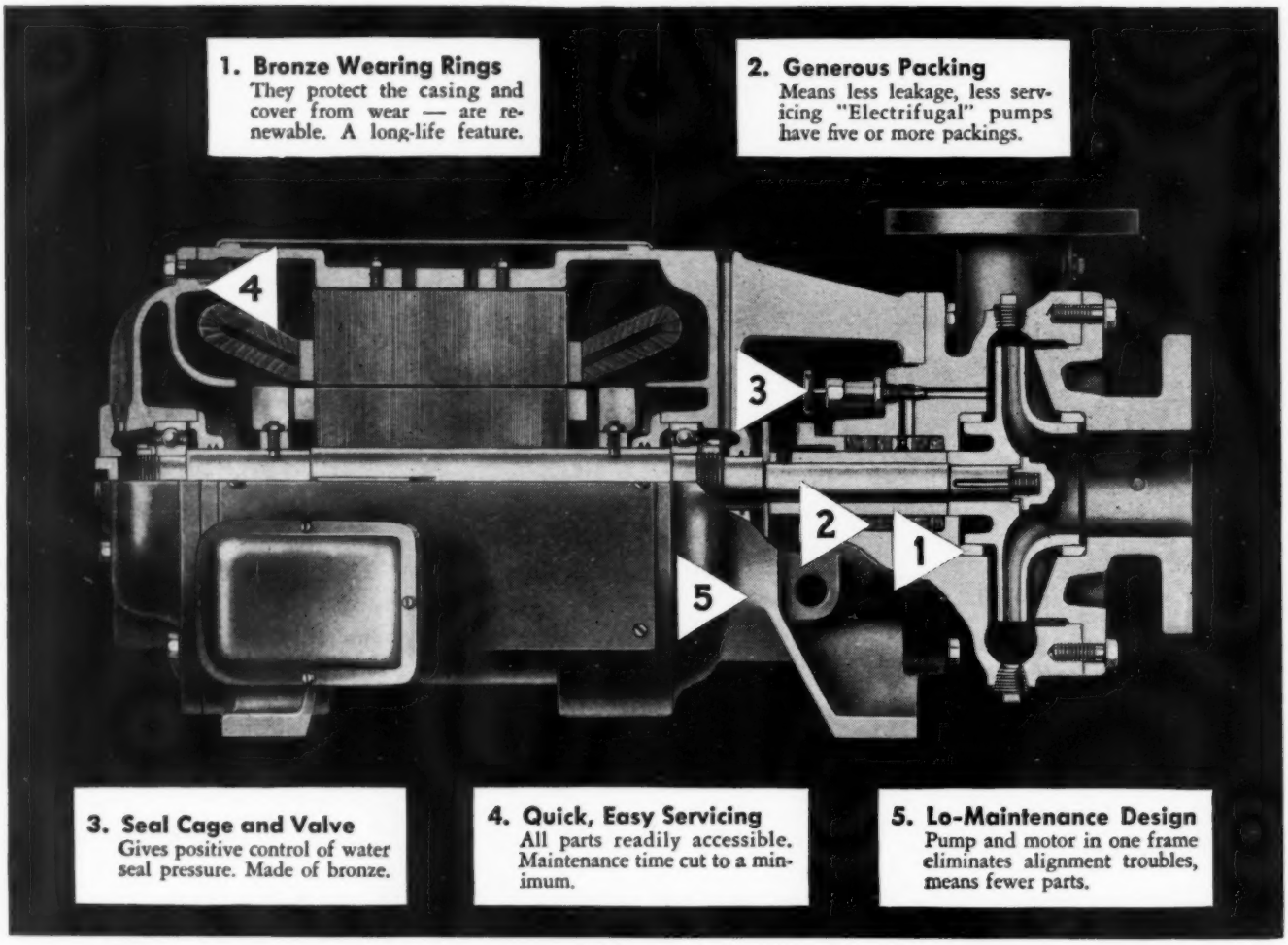
Methods of reducing this consumption can be quickly spotted by studying the peculiarities of operation revealed by the graphic records. These, in conjunction with process production figures, will indicate when and why a department or process uses more of a power plant service than necessary.

Republic engineers will gladly consult with your own engineers on any distribution metering problems you may have. They will show you how Republic meters can help you eliminate power service losses in your production departments. Ask today to have a Republic engineer call at your plant. Your request will involve no obligation on your part.


# Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

# CONSTRUCTION DETAILS
## that cut pump maintenance costs


1. Bronze Wearing Rings
They protect the casing and cover from wear — are renewable. A long-life feature.
2. Generous Packing
Means less leakage, less servicing "Electrifugal" pumps have five or more packings.
4
3
2
1
5
3. Seal Cage and Valve
Gives positive control of water seal pressure. Made of bronze.
4. Quick, Easy Servicing
All parts readily accessible. Maintenance time cut to a minimum.
5. Lo-Maintenance Design
Pump and motor in one frame eliminates alignment troubles, means fewer parts.

## GET THEM ALL...

These fine-construction features are guide-posts to longer service — lower pumping costs. Look for them in the pump you buy.

You get them all — and more — in an Allis-Chalmers "Electrifugal" pump. By mounting pump and motor on the same shaft and in the same frame, Allis-Chalmers engineers not only save space, but they simplify construction and reduce cost. They give you a pump that's quickly installed — operates in any position — has almost endless applications. Made in stock sizes from ¾ to 25 hp.

**PART OF THE COMPLETE LINE**

Other Allis-Chalmers centrifugal pumps and motors in capacities to 170,000 gpm! Single suction, double suction and multi-stage. Call your Allis-Chalmers office or dealer — or write for bulletin No. B6018. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2038

**HEAR THE BOSTON "POPS":** *Every Saturday Evening, American Broadcasting Co.*

**ALLIS CHALMERS** — *Electrifugal* **PUMPS**

# perfect – 17 years ago –

## STILL BETTER TODAY

Feed this stoker the lowest available grade of coal! Watch it operate perfectly—without clogging—on *any* grade—wet, dry, or partially frozen. This "non-clog" feature is *exclusive* with Perfect Spread.

## PERFECT SPREAD STOKER

**—with stationary grates, dumping grates or continuous ash discharge—up to 400,000 lbs. of steam per hour.**

"Something new has been added!" Today's Perfect Spread Stoker, using the same successful principle of operation which distinguished its 17 years of operation, has been re-designed, streamlined, improved.

It combines features not obtainable in any other stoker. It handles all types of coal—efficiently, economically.

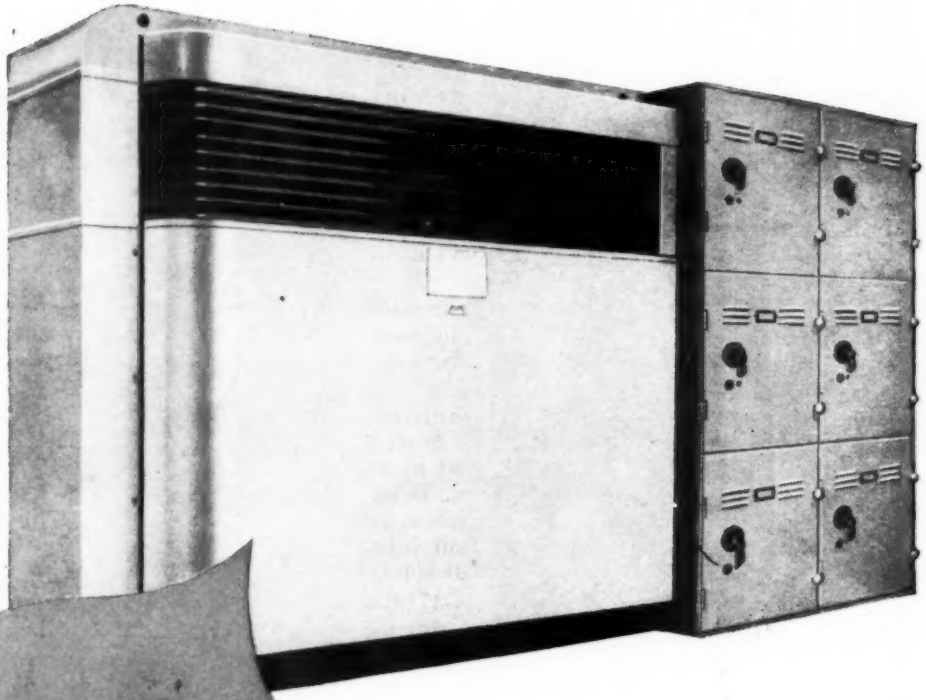
The pleasing, easy-to-clean exterior is indicative of its dependable, quiet operation which brings you both fuel and maintenance savings.

Before you buy any fuel firing equipment, investigate the Perfect Spread Stoker. Write today for descriptive booklet giving *all* the facts!

**Other Æ Products: Æ Taylor Stokers, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power**

**AMERICAN ENGINEERING COMPANY**
**2400 ARAMINGO AVENUE, PHILADELPHIA 25, PENNSYLVANIA**

A typical G-E dry-type substation, made up entirely of standard elements and equipped with metal-enclosed, drawout air circuit breakers. Units like this can be added one-by-one until your entire plant is converted to a co-ordinated load-center system.



# SOUND DESIGN *inside and out...*

## DRY-TYPE

A "bright spot" anywhere in the plant, this G-E dry-type load-center unit substation (150 kva) is completely self-contained, incorporating high-voltage potheads, disconnecting switch, fuses and low-voltage thermal breakers.

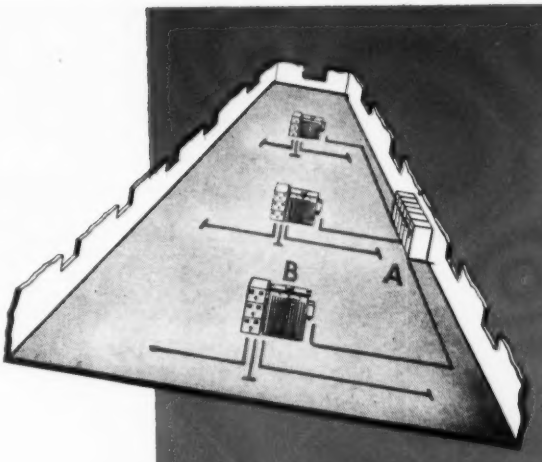
**G-E** dry-type unit substations are styled to meet 1946 requirements for neatness and clean-cut appearance in your plant equipment-layout. Their design simplicity lends itself to ease of location and facility of installation. Their light weight reduces structural problems.

Users who prefer dry-type equipment will find these unit substations at the top of their class in their ability to handle overloads. For, the transformer sections of G-E dry-type unit substations are designed to meet AIEE Standards No. 1 for Class B insulation, with *130 C maximum hot spot temperature* in a maximum ambient of 40 C. They also meet ASA Standards C-57.1, which limit the observable temperature rise to 80 C.

These unit substations have factory-matched switchgear —that is, the interrupting capacity of the switchgear section is matched, electrically, mechanically, and thermally, with transformer characteristics.

G-E dry-type unit substations are repetitively manufactured. This is a feature adding to their flexibility, for as load requirements change, expansion is met by the addition of similarly matched units, block by block. Thus, a planned efficient load-center power distribution system is always in operation in your plant. G-E dry-type unit substations are available in ratings up to 2000 kva, 15,000 volts.

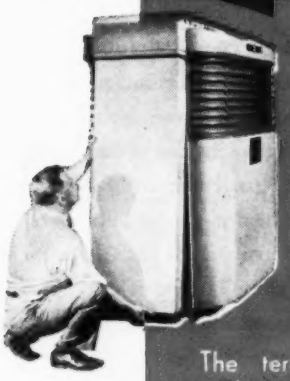
Ask for bulletins GEA-3592A and GEA-3714B. Call your nearest G-E representative or write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*




In a modern load-center distribution system, power is distributed from metal-clad switchgear (A) at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations (B) located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through short secondary feeders.

# UNIT SUBSTATIONS

G-E dry-type unit substations have been supplied in quantity since early in the war-construction period, and sizes and types to meet individual load conditions can now be ordered "right out of the catalog."



The terminal compartment casing extends down the entire side of the substation, facilitating cable entrance connections. The unit can be moved into place after conduit and cable have been made up. On vital conversion jobs, this convenience feature will save many precious hours.

**GENERAL ELECTRIC**

321-44-5900

# FENCED IN?

Being "fenced in" doesn't necessarily mean operating from behind a steel wire enclosure. To a material handling engineer a restricted choice of equipment can be an equally effective hindrance.

No such limitation "fences in" an S-A engineer as he designs the bulk material handling system for a plant. He has an *unrestricted choice* from a complete line of conveyors and accessories, designed and built by the company that for 45 years has led the field with new units and new methods.

And an S-A engineer has that priceless quality of broad *experience* — enriched by close association with a group of progressive conveyor engineers. No wonder the system he specifies can be depended upon to convey the *right* volume to the *right* place, at the *lowest* cost per ton . . . over the long term.

If you want the man who is never "fenced in" to help you solve your bulk material handling problems, talk to an S-A engineer.

**STEPHEN S-A ADAMSON MFG. CO.**

5 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. • BELLEVILLE, ONT

*Designers and Manufacturers of All Types of*
**BULK MATERIAL HANDLING EQUIPMENT**

# Clean Oil Means...

# NO DIRT AND NO WATER!

WATER is just as much a trouble-maker for lubricating oil as dirt is. Frequently, as in the case of turbine oil, it is the ***chief*** offender—for condensate in turbine oil leads directly to the formation of sludge. And of course there is always the possibility that a sudden water leak might occur, and cause serious trouble through emulsification.

De Laval Oil Purifiers remove and continuously discharge any moisture that may get in the oil, whether it is a scant cupful per reservoir or that released by a more serious break. Oil purified by centrifugal force in the bowl of a De Laval machine is ***clean*** in the only sense that makes sense—it is free from ***liquid*** as well as solid impurities.

De Laval Oil Purifiers do not remove oil-soluble additives. Because action is wholly mechanical, there is no danger of such additives being lost in the purification process. This is an important advantage today.

De Laval Oil Purifiers keep oil so clean that its purity can best be compared with that of new oil.

- Why not write for details?

**DE LAVAL**

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

**LUBRICATING OIL PURIFIERS**

# "With the splendid service we get from Hagan, we can't afford to install any other control"

The order for Hagan Automatic Combustion Control on the new boiler in this Midwestern power plant came to us without formal issuance of specifications and without competitive bidding.

"We're giving you this order," the plant engineers told us, "because of the splendid service you have given us on the Hagan Control you installed for us several years ago."

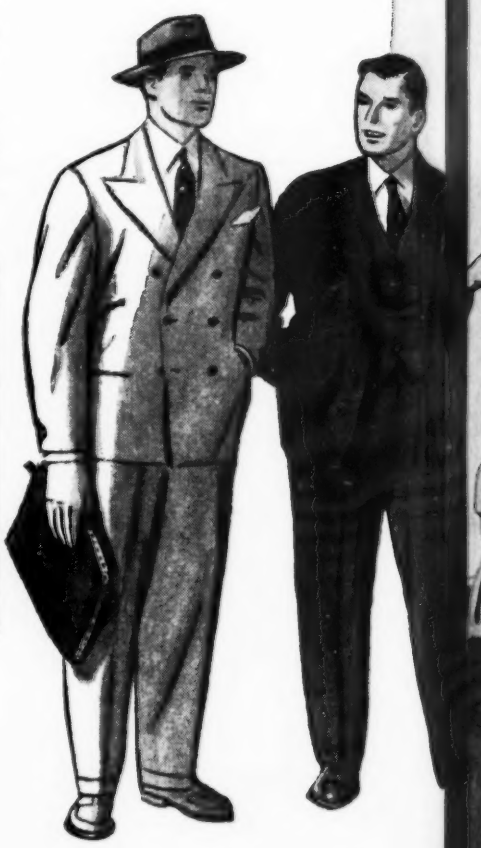
That pleased us—but it surprised us also, for our records showed nothing particularly unusual from our standpoint. Our district representative had visited the plant, not especially frequently, but when he knew that a checkup might be useful. On a few occasions he had called in a service engineer.

Between them, however, they had given whatever attention was necessary to make sure that the control continued to function at top efficiency. The engineers appreciated that fact. "When a company shows such a real interest in our plant," they said, "we can't afford to go along with anyone else on our control business."

Well, we are interested—the kind of interest that doesn't stop when the sale is made, but continues as long as the plant is in operation. That interest pays dividends to the user of Hagan Control, for the service men who represent us are experienced engineers. They know combustion control systems—and they also know boiler plant operation. It is their job to help you get the highest efficiency of which your plant is capable.

When you are considering the installation of a combustion control system, send for the Hagan engineer. His experience is at your service.

All Hagan Control Systems are designed on the principle that *control* and *metering* are separate functions. Only when these functions are kept independent of each other can control equipment have the dependability, ruggedness, sensitivity and speed of response that are essential for the proper operation of automatic combustion control systems.

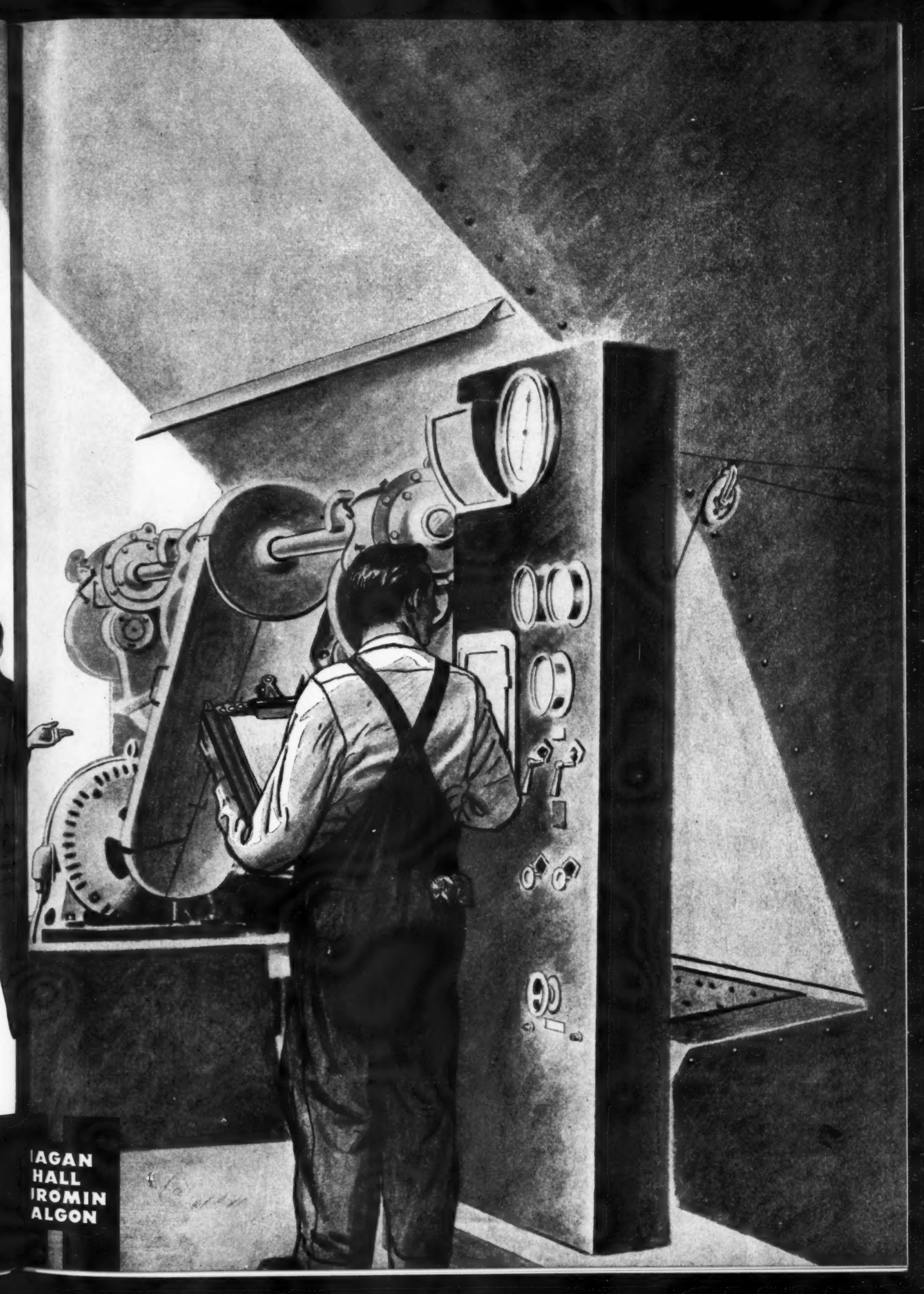


**HAGAN CORPORATION • HAGAN BUILDING**

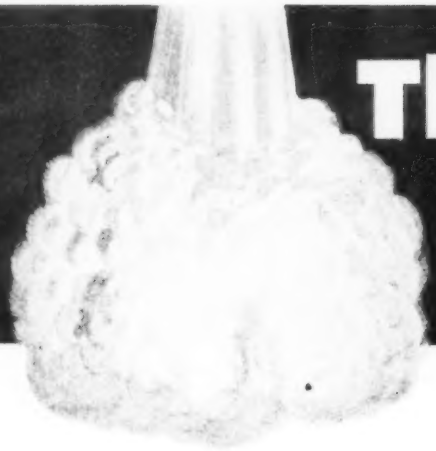
**PITTSBURGH 30, PA.**

**HAGAN *Automatic* COMBUSTION CONTROL**

*The pioneer . . . and still the leader*


AGAN
HALL
ROMIN
ALGON

# The Expensive is the



**SEND FOR CHART**

*showing in dollars-and-cents figures what leaky valves waste in steam, water, and air. Ask your Lunkenheimer Distributor for free copy, suitable for displaying in your plant.*

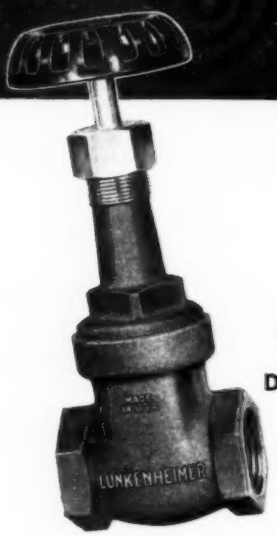



**Fig. 2125 Bronze Double Disc Gate**

**Fig. 1430 Iron Body Gate**

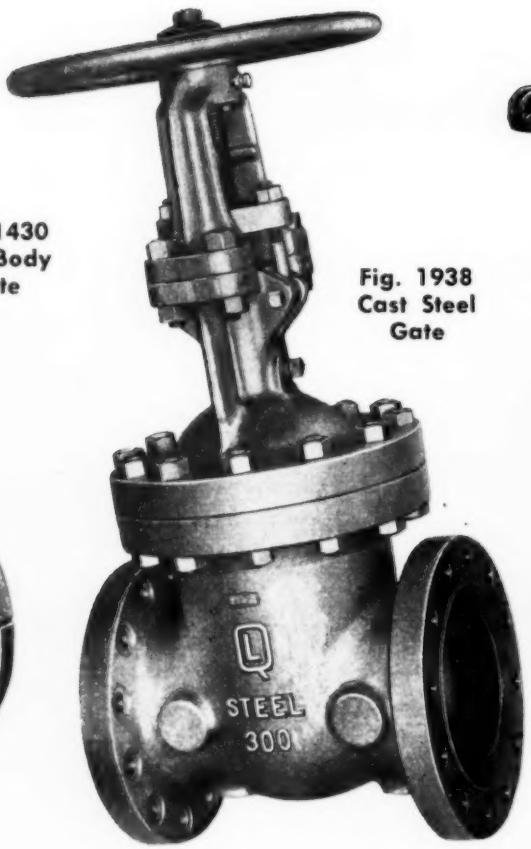



**Fig. 1938 Cast Steel Gate**

**Fig. 1640 "King-clip" Gate**

# LUNKENHEIMER VALVES

# Valve in any plant LEAKY Valve...

## MINIMIZE WASTE— CUT COSTS—with LUNKENHEIMER VALVES

**Don't neglect valve leaks! Even small losses of steam, water, or air can become very costly over a period of time—so costly that every plant management should carefully check all valves at regular intervals.**

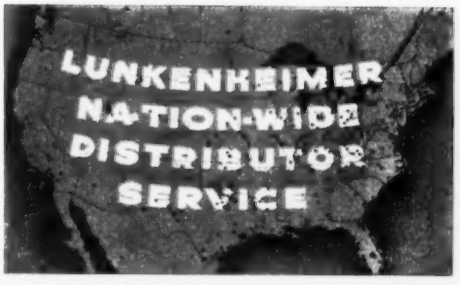
**When quality-built Lunkenheimer Valves are installed, the chance of leakage is reduced to minimum. And even if, after extended service, Lunkenheimer parts should become worn, new parts can be quickly obtained from your Lunkenheimer Distributor . . . *precision-made parts that require no special fitting on the job.***

**The Lunkenheimer ideal, today as for more than three quarters of a century past, is to produce valves that last longer, require fewer complete valve replacements, *cost less per year of service* . . .**

**THE LUNKENHEIMER CO., Cincinnati 14, Ohio, U. S. A. New York 13, Chicago 6, Boston 10, Philadelphia 7. Export Department: 319-322 Hudson St., New York 13, N. Y.**

### Your LUNKENHEIMER DISTRIBUTOR Has A *Complete Stock* of Parts

*You can always rely on your nearest Lunkenheimer Distributor for better valve service. He carries a complete stock of precision-made Lunkenheimer parts, and is equipped to give you real help in solving problems of valve maintenance or operations. Call on him!*




**BRONZE, IRON, STEEL, AND CORROSION RESISTANT ALLOY VALVES**
**AIR DEVICES, LUBRICATORS, AIRCRAFT FITTINGS**

# STEAM COSTS

## WITH IRON FIREMAN PNEUMATIC

**1**

### EFFICIENT COMBUSTION

Thousands of cost records demonstrate Iron Fireman coal saving. More efficient utilization of fuel is due to Iron Fireman's three fundamentals: (1) Positive control of fuel feed and distribution. (2) Positive control of air distribution and diffusion. (3) Positive control of fuel-air ratio.

**2**

### QUICK PICK-UP

The Iron Fireman Pneumatic Spreader stoker is extremely sensitive to load demands. Its unusual flexibility makes this stoker an outstanding performer where power, heating, or processing loads are subject to wide fluctuation. Close automatic adjustment to the load is an important fuel-saving factor.

**3**

### BURNS LOW-COST COAL

The Iron Fireman Pneumatic Spreader stoker not only saves tonnage by Iron Fireman's more efficient combustion, but cuts the cost per ton by using low grade coals. Burns efficiently the small sizes and low ash fusion coals as well as subbituminous and lignite.

**4**

### HAS OWN CONVEYING SYSTEM

The Iron Fireman Pneumatic Spreader stoker does not require costly coal handling equipment. Its conveying system carries fuel from main bunker to boiler (upper right). Coal can be transferred by this means from basement bunkers to boilers on the first or even the second floor above.

**5**

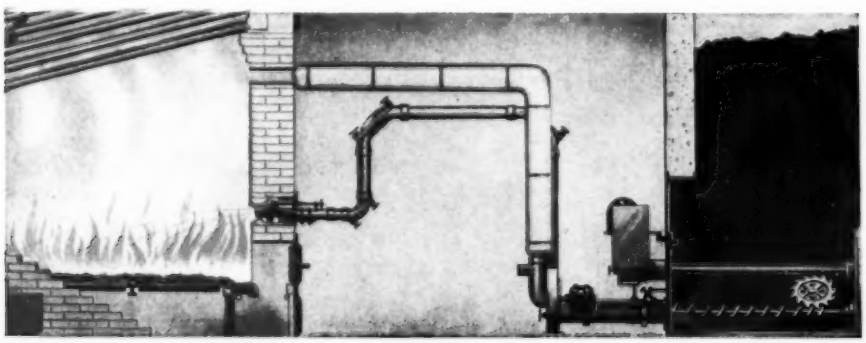
### ECONOMICALLY INSTALLED

The Iron Fireman Pneumatic Spreader stoker requires a minimum of boiler-room alteration. Both the undergrate air and the coal feed nozzles can be introduced at front, rear, or sides of boiler—permitting easy adaptation to almost any boiler-room layout. Installation supervised by Iron Fireman.

**6**

### LOW MAINTENANCE COSTS

No moving parts are subject to furnace heat; all mechanism is readily accessible for inspection and maintenance. Patented long-life grates are protected by constant air currents diffused through a coating of ash which is permanently maintained even on dump grates.



**How the Iron Fireman Pneumatic Spreader Stoker Operates . . .**

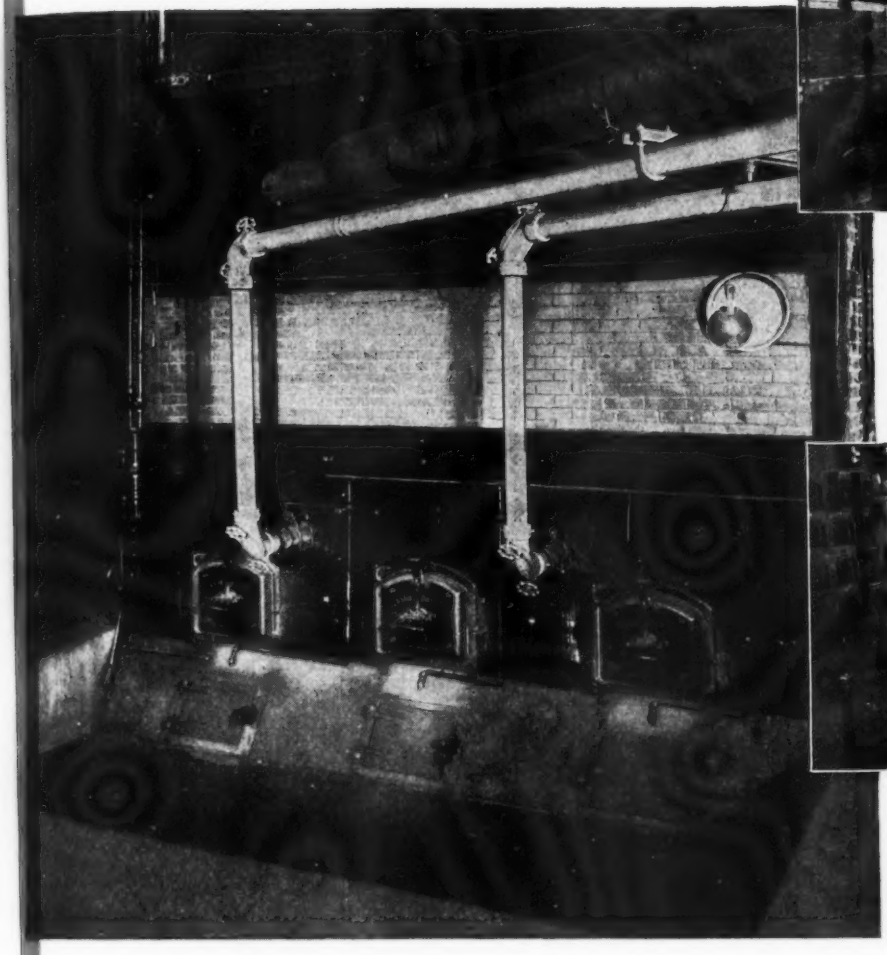
The Iron Fireman Pneumatic Spreader Stoker meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by a pneumatic conveyor and delivered to the furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat fuel.

HEAVY DUTY AUTOMATIC COAL STOKER

IRON

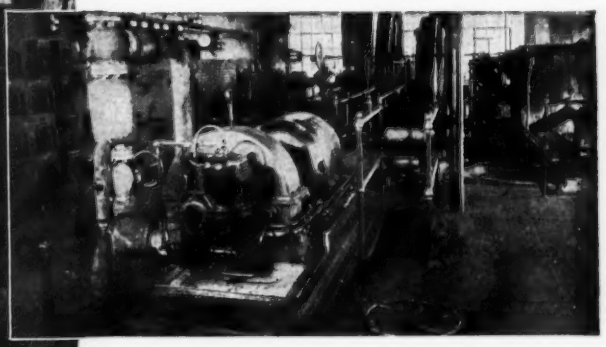
# CUT SIX WAYS

## SPREADER STOKER



**FEEDS FROM MAIN COAL BUNKERS**

Pneumatic conveyors carry coal a distance of 30′ in the W. L. Douglas plant. Coal pick-up section (below floor level at rear) takes coal from bunkers and transfers it to pneumatic conveyor pipes.



**STEAM POWERED GENERATING PLANT**

Steam is used for power, processing, and heating in the W. L. Douglas plant. Shown above is the power plant with both turbine and engine-driven generators.

**Iron Fireman Pneumatic Spreader Stoker in the plant of W. L. Douglas Shoe Company, Brockton, Mass.**

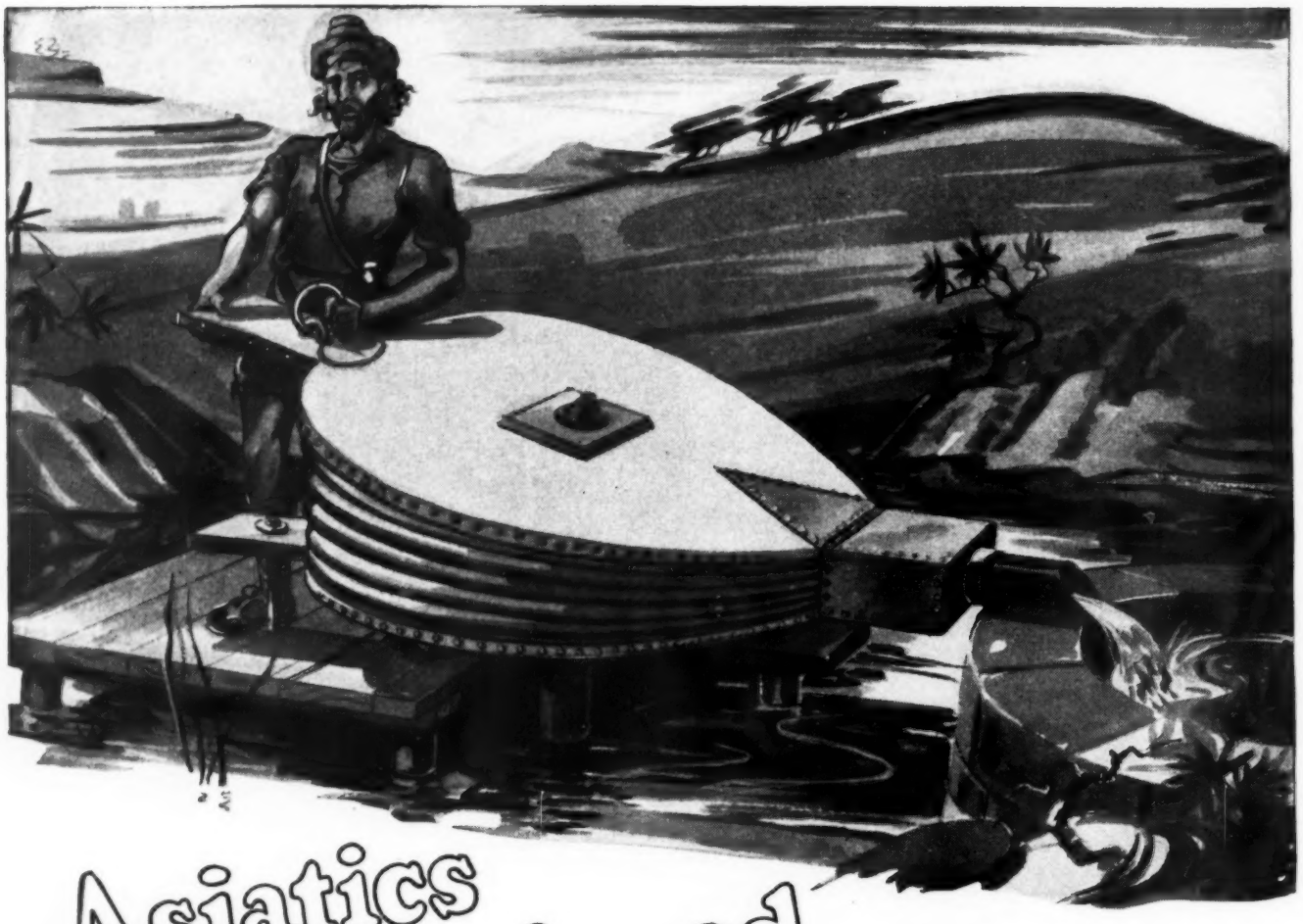
This clean, uncluttered boiler front in the W. L. Douglas Shoe Company plant is a typical Iron Fireman installation. The two pipes which are inserted through the boiler front near the fire doors are the fuel-conveyors which, through adjustable nozzles, spray the coal over the grate area. Hot gases which are used for preheating and conveying the coal are withdrawn from the combustion chamber through the insulated pipes visible at the top of the picture. This installation has increased plant efficiency, and reduced firing costs, according to Mr. C. S. Winchester, Chief Engineer.

**WHAT ABOUT YOUR BOILER ROOM?**

A survey in your plant, made without cost or obligation to you, will show you what Iron Fireman stokers will accomplish in your boiler room. Iron Fireman's nation-wide engineering, sales and service organization has had experience with every size and type of firing job. For such a survey and literature address: Iron Fireman Manufacturing Company, 3045 West 106thStreet, Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada.

# FIREMAN

## FOR POWER PROCESSING AND HEATING



# Asiatics Acclaimed this "Modern" Water Elevator

IMAGINE yourself living four thousand years ago, pumping water with this new Persian invention. What a wonderful improvement it was over lifting water a jugfull at a time from the stream-bed...to irrigate crops or to carry home.

But the world left Persia and this marvelous labor-saving water elevator far behind. Why?

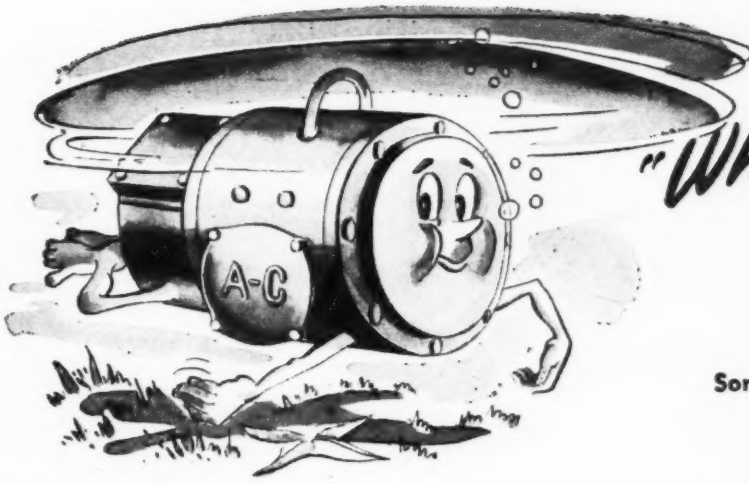
Because the western world discovered plentiful supplies or iron ore, learned how to make steel, how to fabricate it into pipe, sheets, plates, rods, wire, etc., and how to manufacture an endless variety of products that would amaze and confound those ancient Persian inventors. Pumps, valves, tanks, piping and other parts of modern water supply systems are possible for everybody only because steel manufacturers, such as Youngstown, have developed ways to produce steel and steel products in tremendous quantities, at a cost within reach of everyone.

So when you buy or use a piece of steel pipe, inexpensive and commonplace though it is, you may well realize that without our abundance of excellent steel we in America today might be using the ancient Persian water elevator-and still calling it modern.

QUALITY YOUNGSTOWN SERVICE

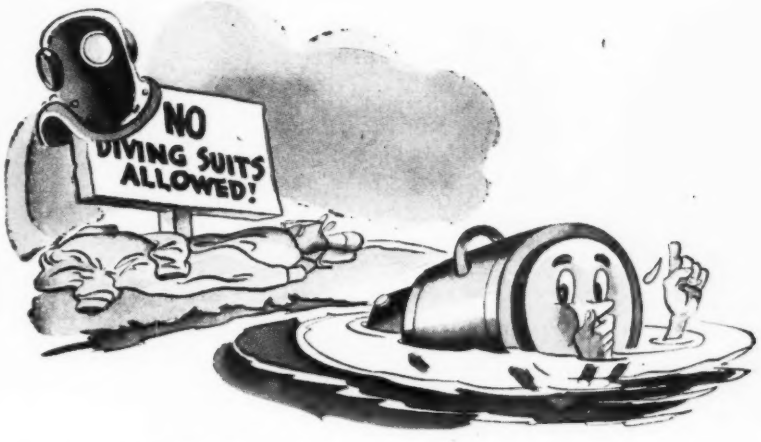
**YOUNGSTOWN**

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN, OHIO
Manufacturers of
CARBON - ALLOY AND YOLOY STEELS
Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Coke Tin Plate - Electrolytic Tin Plate - Rods - Wire - Nails - Tie Plates and Spikes.



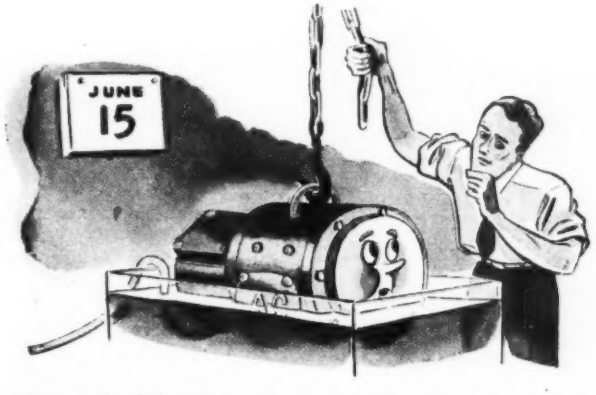

# "What! Build a Motor to Run Underwater for 90 Days?"

**Some said "Impossible!"** But the Navy insisted, "We want a motor that likes water so well it'll run in 25 feet of it for 90 days. What's more—it's got to be lighter, more compact than standard motors."




**No diving suits allowed!** Biggest problem was water-proof, pressure-proof casings. Cast-iron wouldn't do — too porous. So we turned to fabricated steel — tough, durable — and lightweight too!

**Then we found** that fabricated parts could be successfully welded together to assure water-tightness. For proper magnetic characteristics, we decided to use field yokes of one-inch rolled steel.




**Things look better!** We reinforced end-housings, double-checked insulation, made sure exposed parts were leak-proof. Nothing left to do but put our baby in the test-tank, check it regularly, and hold our breath.

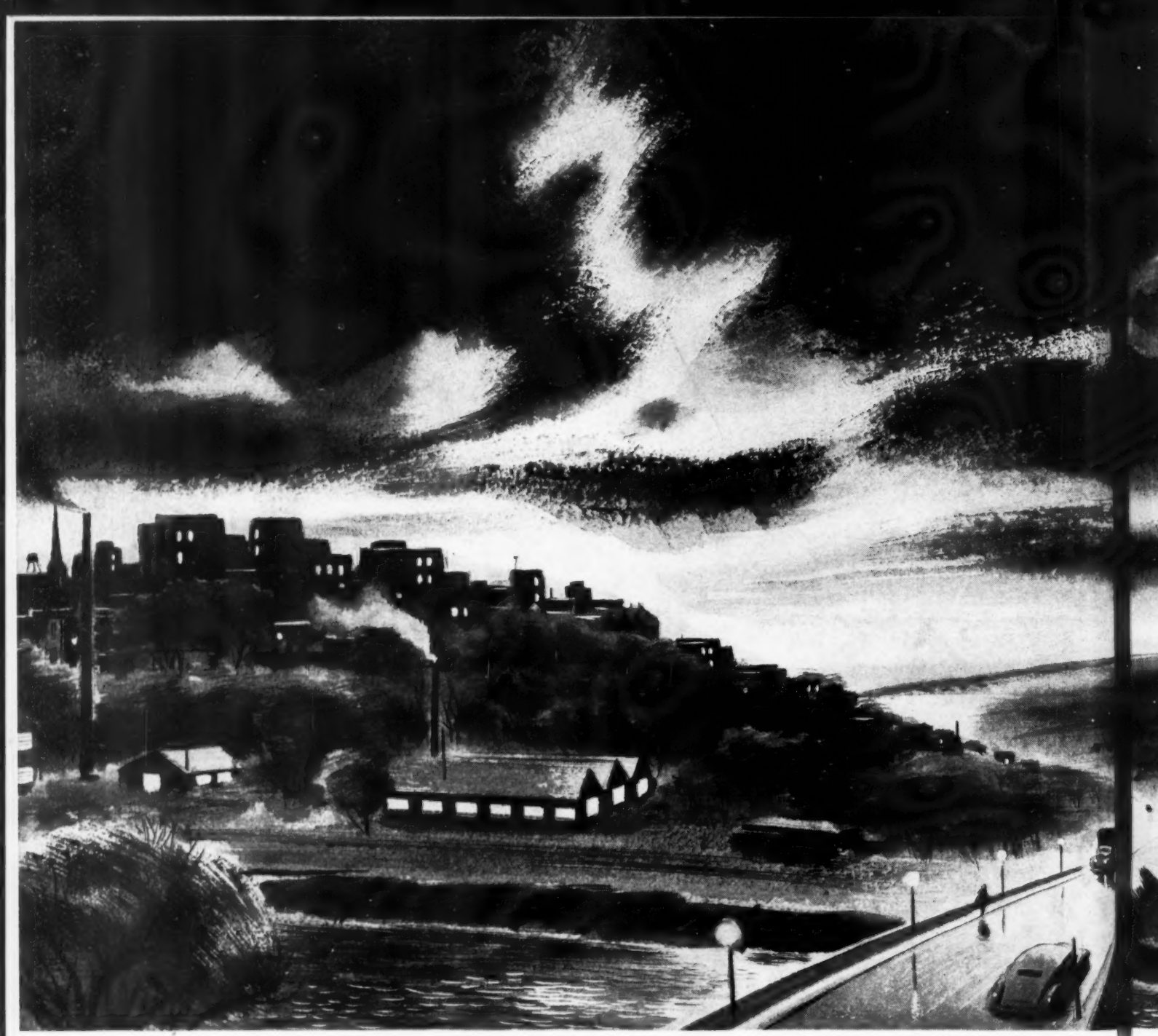
**90 days later**—we took a good look. Motor still running and not a drop of water inside! That called for a short cheer and wide smiles all around. Mass production of these motors followed.

**There's a Moral:** Every time Allis-Chalmers engineering solves *special* motor problems, we discover new ways to build better standard motors for you. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1927

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!



# Light Bringer

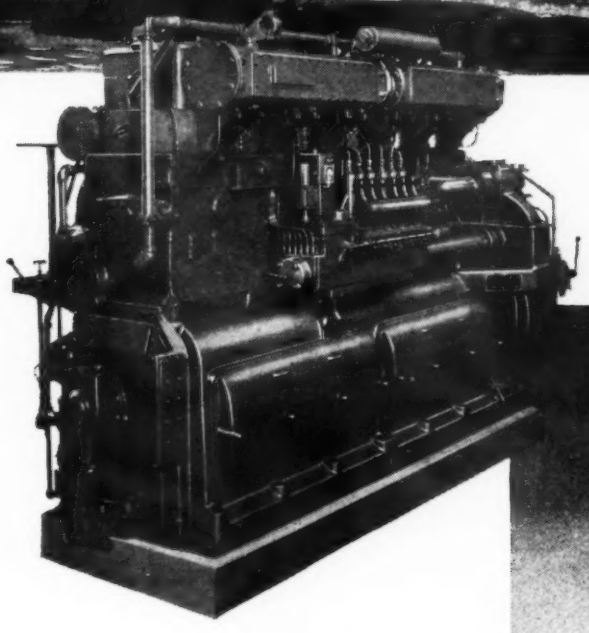
IT IS late afternoon. In the power station, by the river, a generator hums, driven by an ALCO diesel engine. Similar units stand by, waiting.

Overhead a cloud appears, widens, darkens, blots out the sun. Through the sudden gloom lights appear in factories, offices, stores, homes. The power station load shoots upward.

Smoothly, the rising load is picked up as the idle ALCO diesel engines are started. There is no overload, no drop in pressure, no failure of service. Ample power is *immediately* available.

Rugged, compact, high-speed ALCO diesel engines are built for heavy duty; they provide maximum power per pound of engine weight, and per square foot of space occupied.

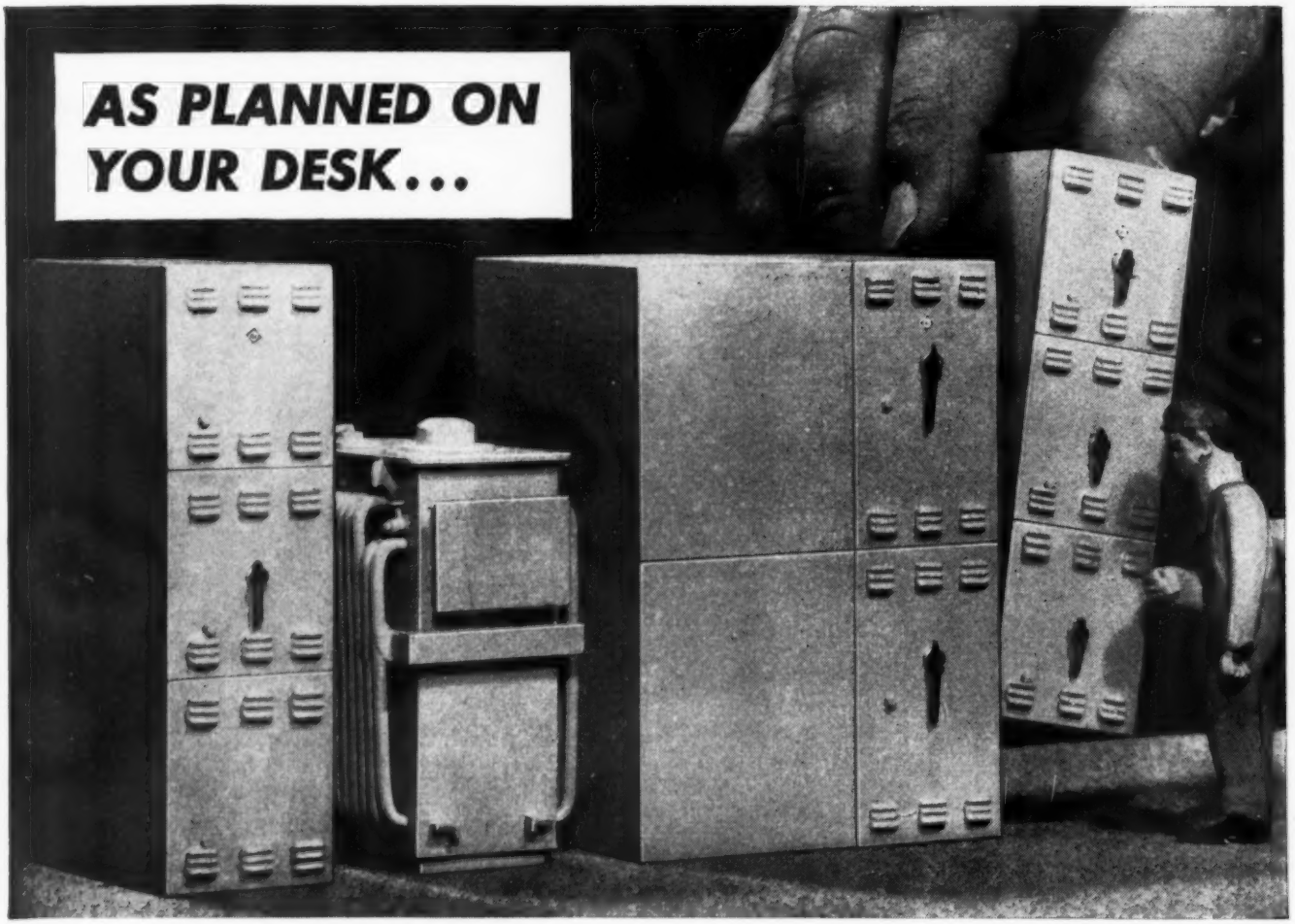
These are important advantages for practically any power unit application for either stationary or marine service.



# American Locomotive

Alco

THE MARK OF MODERN ENGINEERING



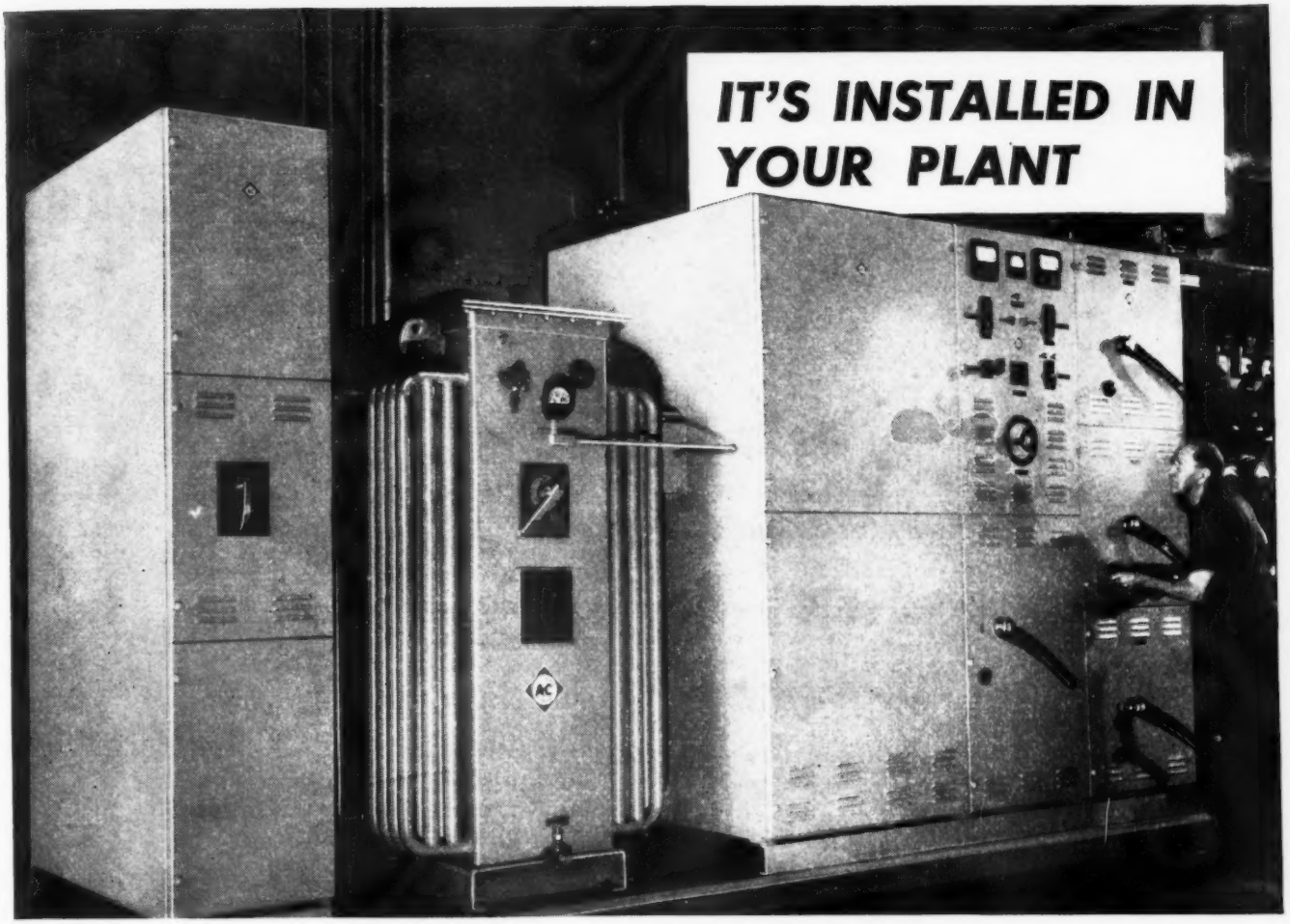

# Buy From Sight,

**PLAN EFFORTLESSLY. PLAN QUICKLY. PLAN ACCURATELY. — IT'S JUST THAT WAY WHEN YOU USE ALLIS-CHALMERS' "UNIT SUB BUILDER" SET TO HELP SOLVE YOUR POWER DISTRIBUTION PROBLEMS. ACCURATE SCALE MODELS OF A-C SUBSTATION APPARATUS SHOW WHAT'S AVAILABLE, HOW PARTS FIT TOGETHER, HOW YOUR UNIT SUB WILL LOOK.**

IT'S SIMPLE, it's practical, it's fast . . . *visual* planning of your power distribution needs with the help of Allis-Chalmers' "Unit Sub Builder" Set.

No longer is it necessary to bog down in complicated catalogues and tables. With accurate scale models of Allis-Chalmers Prefabricated Load Center Unit Substation apparatus, you see what's available, experiment with various arrangements, make comparisons, build solutions . . . *right on the top of your desk.*

Even more important: A-C's accurate models protect you against costly power distribution mistakes. You see what you're getting in terms of dimensions, characteristics, appearance. You make sure that the substation you select is the *right* one for doing the job in your plant.




# and Buy Right!

*—with*

# ALLIS-CHALMERS

*Unit Sub Builder Set*

You'll get an even clearer picture if models are built up on a floor plan of your plant drawn to the same scale . . . ½ inch to 1 foot.

All the elements making up Allis-Chalmers unit substation equipment are contained — in miniature — in the model kit. In addition, there's a handy "Unit Sub Slide Rule" to simplify breaker calculation, and a valuable "Unit Sub Check List" to give you the added planning safety of a *double check*.

In the comparatively short period Allis-Chalmers' "Unit Sub Builder" Set has been available for assisting power distribution planners, engineers of many leading U. S. firms have taken advantage of its time-saving, trouble-saving benefits. They like the idea of working out solutions . . . quickly, easily, accurately.

This complete *and proven* service is yours, with no obligation. To see for yourself how the models, check list, and slide rule can help you in the planning of your power distribution system, call your nearby Allis-Chalmers district office.

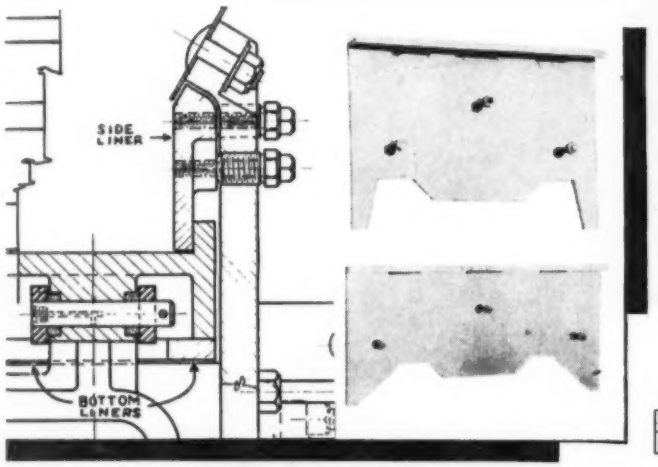
An A-C field engineer will bring the models, together with the slide rule and check list to your office for a showing. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN.

A 1949

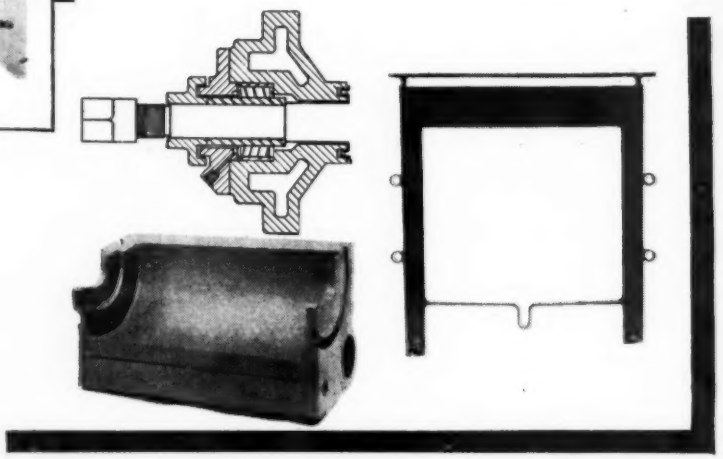
**HEAR THE BOSTON SYMPHONY:** *Every Saturday Evening, American Broadcasting Co.*

# *Contributing to* HOFFMAN

**Through nearly a quarter of a century of specialized experience, Hoffman engineers have built into Hoffman Firite coal feeding units and Hoffman patented grate structures the refinements which have established new standards of low maintenance, high availability and high efficiency in the stoker industry.**




**Easily replaceable, high carbon steel wearing plates protect main stoker frames from abrasion and maintain original clearances.**



**A water cooled face plate imposed between the coal feeding unit and the cast iron front, an air cooled throat piece and a water cooled bearing on both ends of the impeller shaft.**

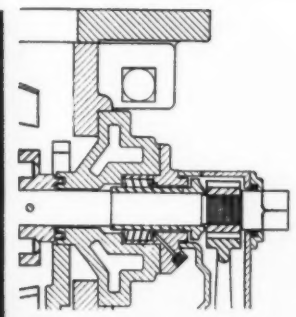
## HOFFMAN COMBUSTION

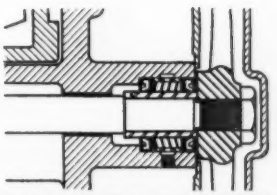
***WORKS AT:*** **FAIRMONT, WEST VIRGINIA**
**DETROIT, MICHIGAN**

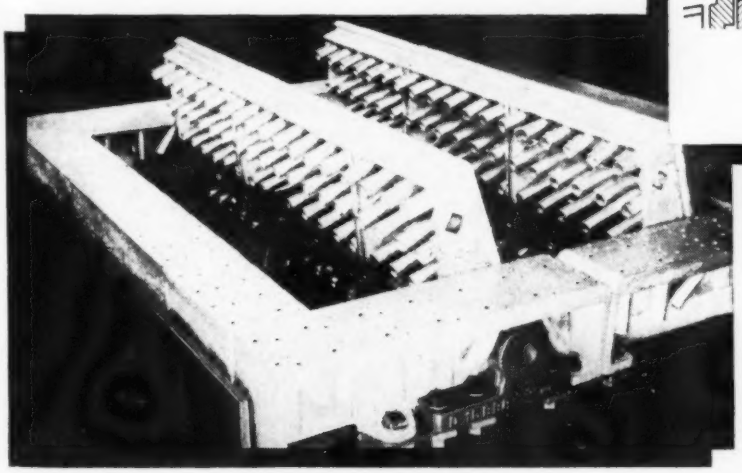
# STOKER *Leadership*

**By protecting moving parts from coal abrasion and protecting coal feeding units from radiant furnace temperatures; by structural features inherent to grate designs furnishing ample protection from fuel bed temperatures and with bearings, gears and pinions dust sealed throughout, low maintenance is assured.**

**Interchangeable Hyatt bearings with dust sealed inner and outer races on both the impeller and the eccentric shafts. Dust sealed gears on both shafts.**







**Uniform arrangement of tuyere openings on surface of grate bars and bearing bars, together with large extended surface by tubes and stiffening webs serve to maintain low temperatures throughout the grate structure and assure long life for the entire assembly.**

Firite SPREADER TYPE

## ENGINEERING COMPANY

**OFFICES:** Marquette Building, Detroit, Mich. Bell Building, Chicago, Illinois
154 Nassau Street, New York City Twenty-Two Marietta Bldg., Atlanta, Ga.

*Agents in industrial centers*

# "THE HANDIEST TESTING INSTRUMENT WE'VE EVER HAD"

*say hundreds of users*

**MEASURES BOTH**

**VOLTS AND AMPERES**

**(ACCURACY 3%)**

## G-E HOOK-ON VOLT-AMMETER

**You get double value from this handy, portable, a-c instrument. It will measure up to 600 volts and up to 600 amps. Just hook it around the conductor, push to close the gap, and read the current. Leads are provided for voltage measurements. Booklet GEA-2950 gives complete details, prices, and many helpful suggestions for operating this versatile instrument. Ask your G-E representative or write General Electric Company, Schenectady 5, New York.**

HEADQUARTERS FOR MEASUREMENT

**GENERAL ELECTRIC**

602-94-6200

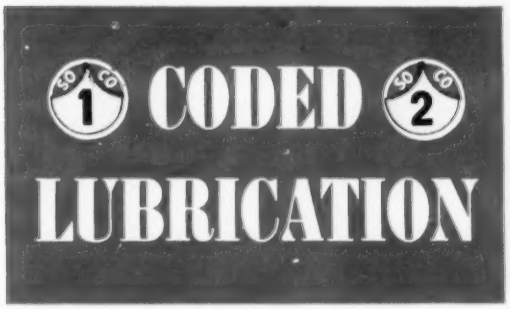
# Two services that help you to lower lubrication and maintenance costs

TWO HELPFUL services described at the right are offered by Standard Oil to manufacturers in the Middle West. They are designed to take guess work out of plant lubrication. First, by providing experienced Lubrication Engineers to help you choose the right lubricant for every application. Second, by insuring that the *right* lubricant is applied in the *right* places by means of a coded lubrication system. You can get both of these services by writing Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, and asking for the Lubrication Engineer nearest you.

## Lubrication Engineering Service

Standard Oil has experienced Lubrication Engineers located in principal cities throughout the midwestern states shown on the map.

These Engineers have two advantages when analyzing your lubrication needs. They are familiar with the operation of all types of plant equipment — as are your plant personnel — and they have a complete knowledge of the lubricants available to meet your requirements. Thus Standard Oil Lubrication Engineers can help you *get the right lubricant.*




In addition, these Engineers can supply you with a simple Coded System for applying lubricants. Briefly, the system provides for numbering all lubricants used in your plant. Every drum, oil can, or grease gun used for dispensing lubricants is identified by a number to indicate the lubricant it contains. Each spot to be lubricated is also marked by a number to indicate the lubricants required.

Your oilers follow the code numbers. The *right* lubricant is applied to the *right* places every time.

**STANDARD OIL COMPANY (INDIANA)** STANDARD SERVICE

# Fewer oil changes... less deposit with improved

# STANOIL

FOR 18 YEARS Standard has provided an oil containing additives to reduce oil oxidation and formation of acidity and deposits in turbines.

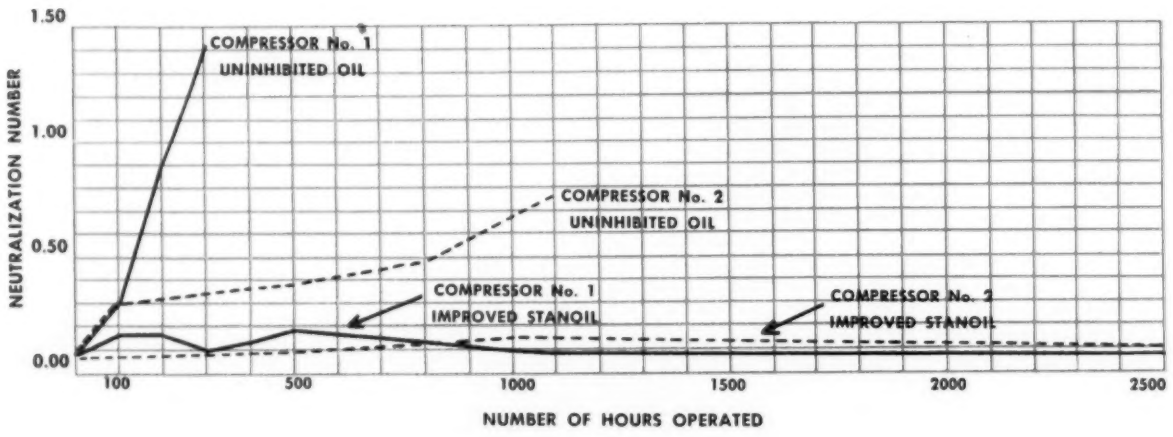
Now Standard has developed and incorporated in Stanoil an additive which improves oxidation resistance for a wide range of industrial applications. Improved Stanoil has been tested under the most severe operating conditions on many types of service: compressors, reduction gears, circulating and hydraulic systems.

Records of one of these severe tests in two compressors are charted below. They show the greatly reduced rate of acidity formation in Improved Stanoil as compared with oils previously used.

Try Improved Stanoil. Compare oil replacement records with the oil you now use in gear cases, circulating and hydraulic systems. Note how Stanoil reduces deposits in compressors.

A Standard Oil Lubrication Engineer will help you make a test. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

**Adverse operating conditions and 24-hour a day operation imposed severe demands on the lubricating oil in two mine compressors. Conventional oil rapidly increased in acidity, as shown by the chart. Improved Stanoil maintained a safe low acidity throughout the 2500 hour test on Compressor No. 1 and for an additional 700 hours on Compressor No. 2 until it was shut down. Make-up was comparable with both oils.**




**STANDARD OIL COMPANY (INDIANA)** STANDARD SERVICE

**Whatever combination of conditions your springs must fight...**

CORROSION • RUST • HEAT • COLD • HIGH STRESS • FATIGUE

**Whatever type of spring you need...**

COMPRESSION • EXTENSION • TORSION • SPIRAL • FLAT • CLIP • RETAINER • GARTER • BANANA

**Consider these alloys first...**

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There is no need to put up any longer with repeated troubles that can be avoided by using INCO Nickel Alloy springs for corrosive conditions and elevated or sub-zero temperatures.

*Now,* rustless, high-strength springs can be made of five different INCO Nickel Alloys to withstand corrosive attack and temperatures up to 750°F. or even higher.

And they cost so much less than special alloy springs that it is practical to use them for any application where heat, corrosion or fatigue are causing you trouble with ordinary spring parts.

NICKEL INCO ALLOYS
TRADE MARK

**HERE'S A CHANCE TO GET RID OF THE SPRING PROBLEM THAT HAS BEEN BOTHERING YOU**

Send for "ANALYZING THE SPRING PROBLEM." When you get this simplified worksheet, jot down the data about your spring problem and what you want in a spring. The information you supply, plus our service records and test data, will enable us to judge which material can be recommended for your particular service. Then, we will cooperate with your spring manufacturer to work out the answer to your problem. That is all you need to do. Write today for "ANALYZING THE SPRING PROBLEM."

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N. Y.

# A Complete *Water Conditioning Service* is a "MUST" for EFFICIENT BOILER OPERATION

● Among important factors contributing to the efficient operation of a modern steam power plant are adequate and well-maintained auxiliaries, properly controlled combustion, clean heating surfaces —and correct boiler water conditioning. All these factors are primary and essential; they must be constantly checked with a completeness that leaves nothing to chance.

In the matter of water conditioning, the service furnished by W. H. & L. D. BETZ is complete and thorough in every respect. All phases of chemical conditioning and control are carefully coordinated to result in a service engineered to fit each plant's particular requirements.

Briefly, Betz service embraces an exhaustive initial investigation, the establishment of a plant control, a daily testing program for the boiler room operators, periodic check-up visits by Betz field engineers, check analyses of water samples in the Betz laboratories, and finally, regular and frequent engineering reports on plant operations from the Betz engineering service division.

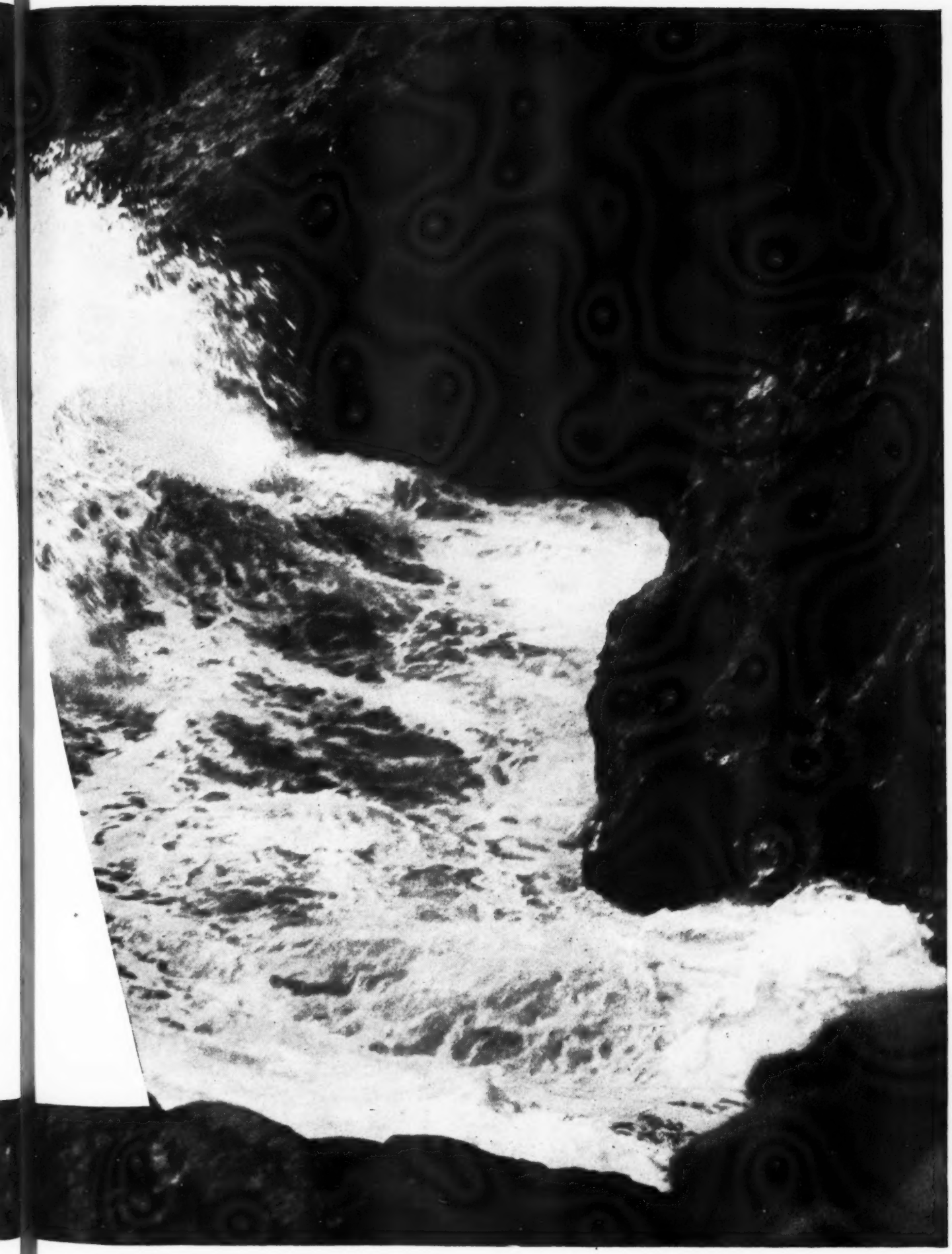
W. H. & L. D. BETZ has a large force of field engineers ready to serve you. If your boiler feedwater conditioning service is not as complete as it might be, we will welcome the opportunity of showing what we are able to offer.

*Send for the illustrated booklet giving a complete outline of the 6 fundamental steps in Betz boiler water conditioning service. Ask for Bulletin 46-A. W. H. & L. D. BETZ, Gillingham & Worth Sts., Philadelphia 24, Penna.*

**BETZ**

**BOILER WATER CONDITIONING • COOLING WATER CONDITIONING**
**INDUSTRIAL WASTE TREATMENT**

Cover photograph from the *Betz Indicator*, a monthly publication devoted to the chemistry and practical applications of water conditioning. The *Betz Indicator* will be mailed without charge at your request.



# The material in a valve must

# POWELL

100 YEARS in the School of Experience has taught us many valuable lessons. Not the least of these is the importance of using the *right* valve in the *right* place. Not only type and design but *material* as well must be "just what the doctor ordered."

It is poor economy to use iron when steel is definitely indicated. On the other hand, if iron is thoroughly adequate for the job, there's no sense in using a more expensive material.

The Powell Line of Valves for Power Plants includes Bronze as well as Iron Valves for every service where these valves are applicable. And to meet the modern trend toward higher pressures and temperatures in power installations, Powell offers a complete line of Cast Steel Valves of all types and sizes in pressure classes from 150 to 2500 pounds. This includes an outstanding line of Non-return Valves designed and engineered to afford positive protection for boiler installations.

Fig. 1793

Fig. 1361 W. E.

Catalogs on request. Kindly specify whether you are interested in Bronze and Iron or Cast Steel Valves, or both. If you have any flow control problems, Powell Engineering is at your service to help you solve them.

**The Wm. Powell Company, Cincinnati 22, Ohio**

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL

# suit the service. has all kinds!

Fig. 241

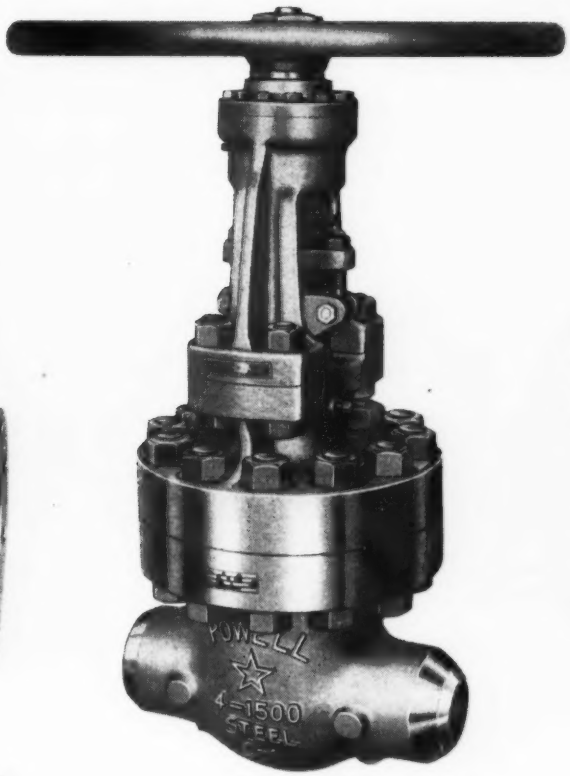



Fig. 1303 W. E.

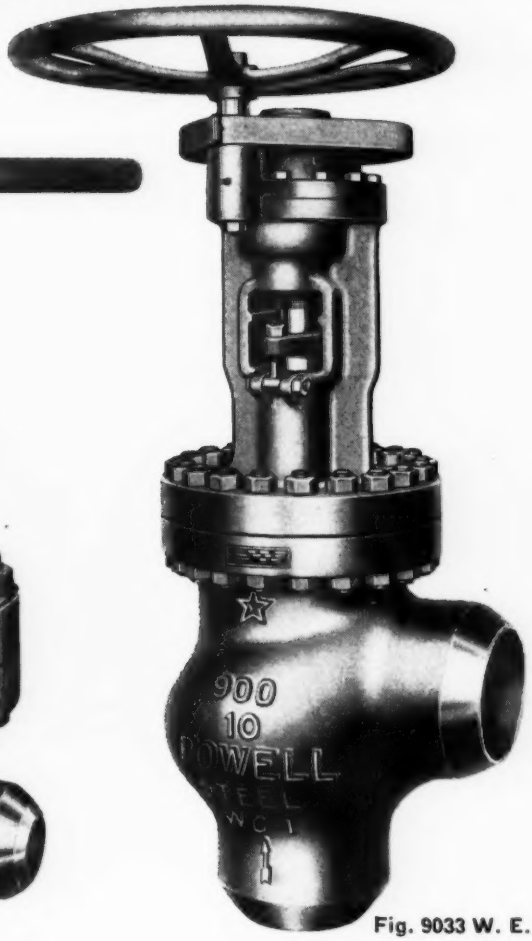



Fig. 9033 W. E.

Fig. 559

**Fig. 1361 W. E.**—Class 1500-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc is hung on a 5-degree angle and, when wide open permits full unobstructed flow through the valve body.

**Fig. 1793**—125-pound Iron Body Bronze Mounted Gate Valve. Has flanged ends, outside screw rising stem, bolted flanged yoke, bronze seat rings and taper wedge solid disc. Also available in All Iron.

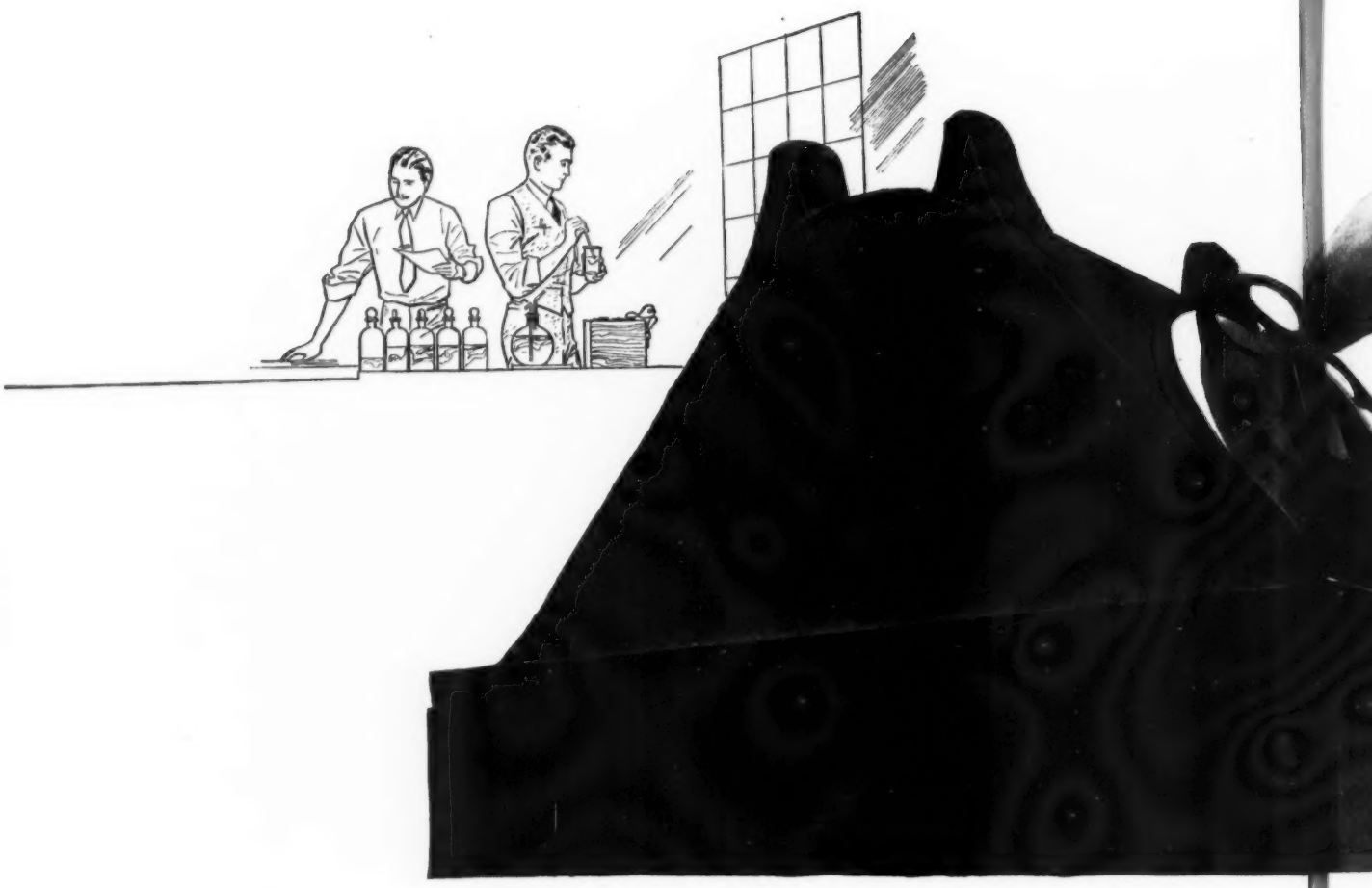
**Fig. 241**—125-pound Iron Body Bronze Mounted Globe Valve. Has flanged ends, outside screw rising stem, bolted flanged yoke, and regrindable, renewable bronze seat and disc. Also available in All Iron.

**Fig. 1303 W. E.**—Class 1500-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc.

**Fig. 9033 W. E.**—Class 900-pound Cast Steel Non-return Angle Valve with welding ends. Spur gear operated. Powell Non-return Valves are available with spur gear, bevel gear or toggle operation. If desirable, electric motor operators for remote control can be provided.

**Fig. 559**—125-pound Iron Body Bronze Mounted Swing Check Valve. Has flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Disc, when wide open, permits full, unobstructed flow through the valve body. Also available in All Iron.

# VALVES



# *the Hall engineer showed*

The 450 psi, 80,000 pounds per hour cross-drum boilers at a southern power plant had to be pushed hard to meet wartime demands. As a result, when one was taken out for inspection a hard black scale half an inch thick was found to have been formed in the tubes of the lower rows of the upper generating bank, in spite of the fact that satisfactory boiler water conditions had been maintained.

The insurance inspector recommended turbining. This turned out to be a long and tedious task. As much as four hours was required to get the turbine through a single tube.

A sample of the scale was rushed to Hall Laboratories. Analysis showed the presence of large amounts of sodium phosphate, sodium silicate and sodium sulphate, leading to the belief that the deposit would be largely water-soluble.

The Hall service engineer for that territory, who happened to be in Pittsburgh, went to work on the problem. Boiling the material in water gave negative results, probably because the high temperature to which it had been heated in the tube had glazed the sodium silicate.

Dilute hydrochloric acid also gave negative results, which

**HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.**

(A subsidiary of Hagan Corporation)

**HAGAN**
**HALL**
**BUROMIN**
**CALGON**

# how to cut turbining time 90%

should probably be attributed to the formation of a film of silica over the deposit as some of the sodium silicate was attacked by the acid.

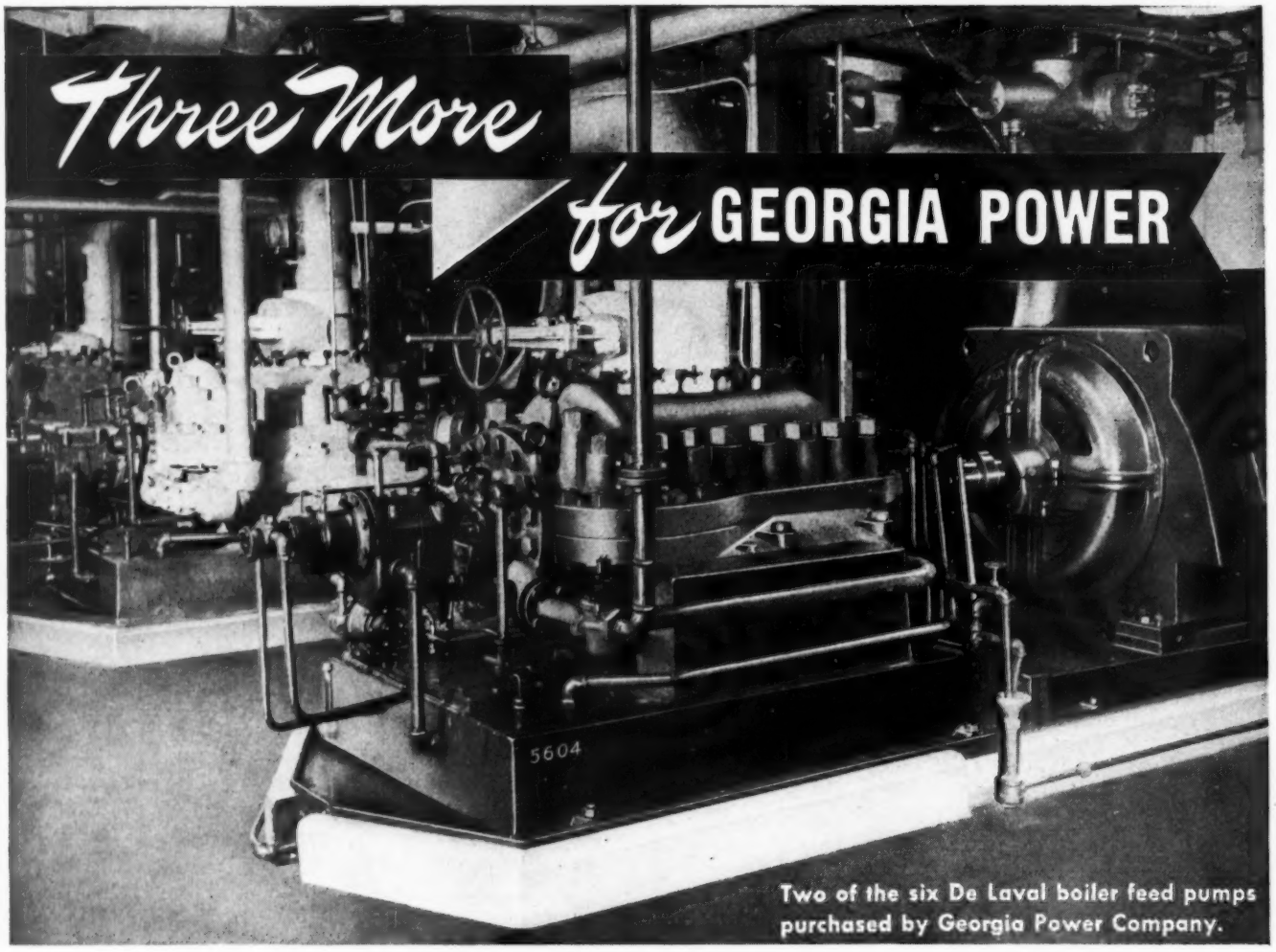
Boiling the scale in a two percent caustic soda solution gave the results desired. Much of the material was dissolved and the rest was so softened that it could be broken up easily. This information was at once telephoned to the plant engineer. He arranged to purchase caustic soda and sodium nitrate, the latter recommended as a safeguard against embrittlement. The Hall service engineer went to the plant to supervise the boiling out of the boiler.

When the boiler was drained and flushed out it was found that the deposit had softened to such an extent that the turbine could be put through a tube in 15 to 20 minutes, instead of 3 to 4 hours.

That incident is typical of Hall Service. When trouble occurs, Hall engineers have just one assignment—to end that trouble and get the boiler back on the line at the earliest possible moment.

Every plant that generates its own steam can profitably use Hall Service. Write for full information.

**HALL SYSTEM** *of Boiler Water Conditioning*



Two of the six De Laval boiler feed pumps purchased by Georgia Power Company.

# Reliability of DE LAVAL Boiler Feed Pumps Demonstrated in HIGH PRESSURE Service

**Three De Laval high pressure boiler feed pumps were purchased by the Georgia Power Company several years ago. Their performance has proved so satisfactory that subsequently three more De Laval units were ordered. Each of the latest units has a capacity of 1455 gpm. against 1013 psi discharge at 1770 rpm., handling 316° F feed water.**

**The satisfactory performance of De Laval pumps in high pressure service is due, among other things, to the rigidity of De Laval solid end head construction, the automatic action of the De Laval hydraulic balancing arrangement, and the leak-minimizing effect of De Laval Labyrinth Wearing Rings.**

**In other installations De Laval boiler feed pumps have proved their dependability handling high temperature feed water at pressures of up to 1600 psi.**

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**DE LAVAL**

**STEAM TURBINE COMPANY**
**TRENTON 2, NEW JERSEY**

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## MAY, 1946

VOLUME 90, NUMBER 5


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TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
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TRANSMISSION, LUBRICATION
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*Cover photo, courtesy Allis-Chalmers Mfg Co*


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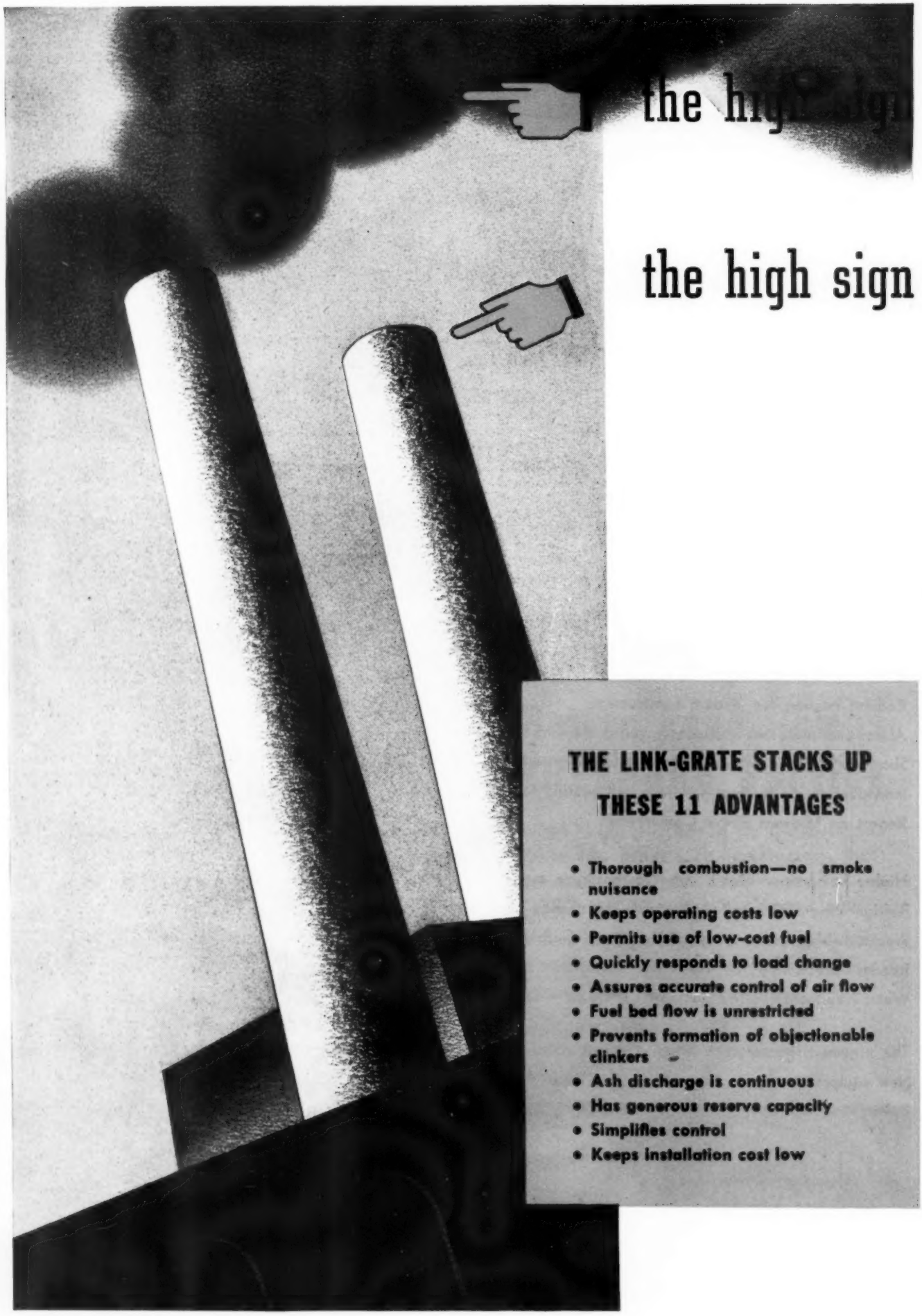

# the high sign

## THE LINK-GRATE STACKS UP THESE 11 ADVANTAGES

- Thorough combustion—no smoke nuisance
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- Assures accurate control of air flow
- Fuel bed flow is unrestricted
- Prevents formation of objectionable clinkers
- Ash discharge is continuous
- Has generous reserve capacity
- Simplifies control
- Keeps installation cost low

# of inefficient combustion

# of a *Link-Grate* stoker

**Smoke Abatement is Waste Abatement with a Westinghouse Link-Grate Stoker**

You'll get less smoke—and, of course, more power—per pound of coal with a Westinghouse Link-Grate Stoker. That's been proved in one installation after another . . . and it's a fact that will win approval from your own fuel cost sheets, from the Smoke Inspector and your neighbors.

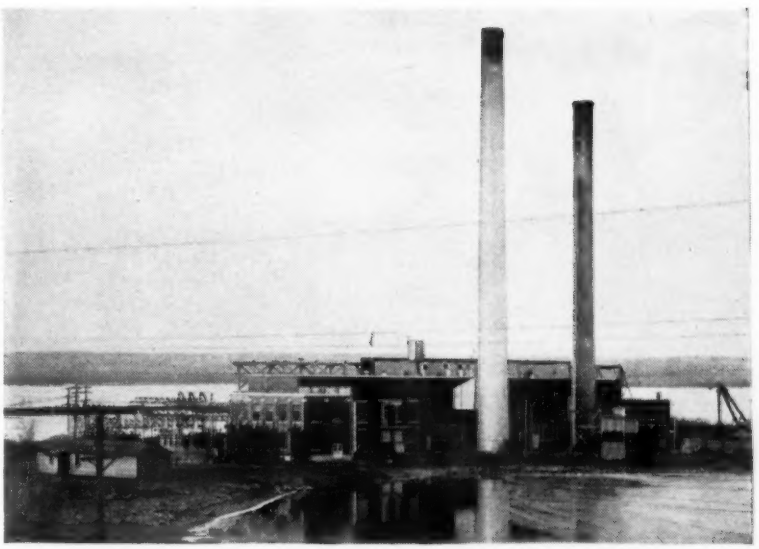
The Link-Grate action does all this by maintaining a regular combustion rate because it continuously processes the fuel bed to keep it porous. With this action, positive motion at the rear of the stoker permits uniform flow of coal over the underfeed section to keep the burning lanes open.

In Link-Grate action, the grates first hinge up to break open the fuel bed and let low pressure air flow through the grates. The reverse movement of the grates crumbles and conveys the burning fuel.

Because of this conveying movement of the Link-Grate, ash comes off the ash discharge plate continuously—doing away with periodic dumping and reducing labor. Clinkers are not a problem.

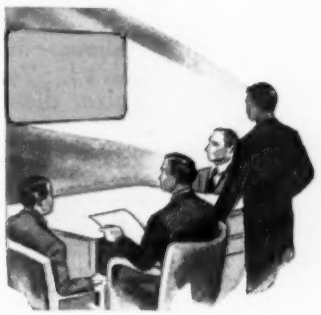
Since the fuel bed is always porous, the Link-Grate Stoker can meet suddenly increased steam demands quickly with full combustion efficiency.

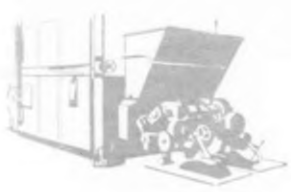
Get the complete information about the Link-Grate before you make an investment in stokers. If possible, see one in operation. Your nearest Westinghouse office will be glad to arrange an appointment with a user. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-50469



Almost no smoke is coming out of the stacks although the boilers are in operation at this power plant of the Lake Superior District Power Co. at Ashland, Wisconsin. In this installation are two 6-retort, SDL-29 Link-Grate Stokers. (Photograph is not retouched.)

**Show Link-Grate Movies in Your Own Office.** A 15-minute sound moving picture has been produced to show in detail the operation of a Link-Grate Stoker. Whether you can visit an actual Link-Grate Stoker in operation or not, this interesting 16 mm. film will show you its action and explain its points of superiority while you sit at your desk. To borrow a print of this film for your own private showing, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.





Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

*Link-Grate* STOKERS

The threat of corrosive attack from combustion products that is always present in steam plants doesn't disappear when diesel power is used. The exhaust gases contain the same ingredients for trouble—water vapor and carbon compounds—as fuel gases. And experience suggests the same defense—Byers Wrought Iron.

One application of Byers Wrought Iron in this service is shown in the illustrations—30 inch I.D. exhaust manifolds for 2 cycle, 3060 HP Busch Sulzer diesel engines. They were made by the Fabricated Metal Products Co. of St. Louis. The resistance of Byers Wrought Iron to the acids formed by combustion products has been conclusively demonstrated, and years of experience endorse the choice of this material.

Almost every plant engineer has a lot of repair and replacement work ahead and there has never been a better time to review the records of corrosive services, and investigate whether a change in materials would mean a change for the better in useful life. In every application where it is regularly used, wrought iron has had to justify itself by greater durability. Its record is an excellent guide in specifying for lowest-cost-per-year.

The reason why wrought iron serves so well in corrosive applications is found in its unusual composition and structure, which are duplicated in no other material. Tiny fibers of glass-like silicate slag—200,000 or more per square inch of section—are threaded through the body of high-purity iron. These fibers act like a series of baffles, halting and dispersing corrosive attack, and discouraging the pitting and penetration that causes failure of ordinary materials. The fibers also help anchor the initial protective scale, which shields the underlying metal, just as a scab protects a wound.

In connection with your plant reconditioning activities, you'll find it convenient to have a Byers General Catalog at hand. It gives full dimensional information on all Byers products—tubular and hot rolled, wrought iron and steel. We will be glad to send you a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Seattle, San Francisco.

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# POWER

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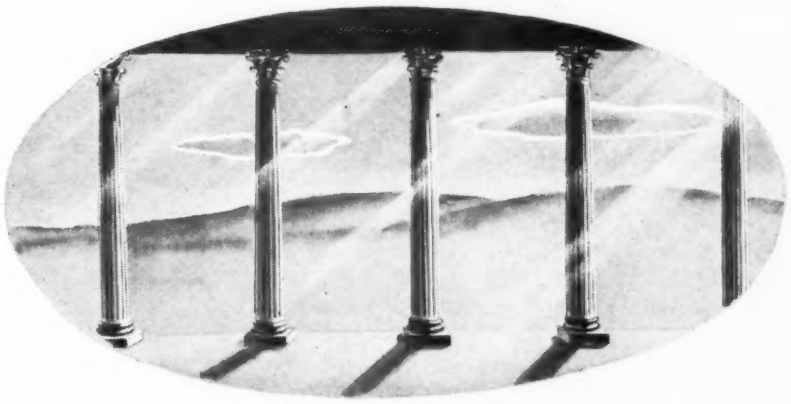


## The Beginning of Atomic Wisdom

INFORMED, INTELLIGENT PEOPLE throughout the world now live in fear of the potential death and destruction that lie behind the unlocked door of the uranium nucleus. To know this atom for what it is—and respect it accordingly—is the beginning of wisdom in this atomic age, now nine months old.

The next step in wisdom is to seek some technically and humanly *workable* protection against atomic weapons.

Today the United States has a monopoly of atomic weapons, plants, know-how, and stocks of fissionable uranium and plutonium concentrates, but we can't hold that monopoly much more than five years. After that Americans must live in constant mortal danger unless right now we nip the budding atomic arms' race.

Of course we shall and should seek technical defenses against atomic bombs and rockets, but this search will probably fail.

Practical men must face (1) the reasonable conclusion that international control is the only way to avoid atom wars more bloody and destructive than any the world has ever known, and (2) the fact that most of the well-publicized schemes of international atomic control have been starry-eyed and unworkable, with human nature as it is.

Here, indeed, was a dark picture until March 29, when the State Department published the unanimous report of its atomic consultants: Chairman Lilienthal of TVA, Oppenheimer of Cal Tech, Thomas of Monsanto Chemical, Winne of General Electric, and Barnard of New Jersey Bell Telephone.

This document may well become the turning point of the atomic age, the guidepost out of today's universal confusion—the first glimmer of a new day.

Certainly this report is an outstanding act of statesmanship and leadership because it so wisely relates the facts of atomic life to the world as it is and to people as they are. Here, for the first time, are outlined the essentials of a humanly workable plan of international atomic control—a hard-headed constructive approach to a problem that had seemed almost beyond human capacity.

The Lilienthal proposals clearly separate the internationally "dangerous" from the non-dangerous operations. They would insure complete international control of the mining, stocking and processing of uranium and thorium and of the production of U235 and plutonium. At the same time, they free for private exploitation "denatured" U235 and plutonium and certain safe types of power plants and other "reactors."

There is no space here for further details, but all power men should study and discuss this great report. It will be summarized in June POWER, and also be published in full as a book.

# New Boiler Gives Needed Capacity and Reduces Steam Costs 20%

***Substantial saving results from unit's efficiency and elimination of coal firing under two refuse-burning boilers. Designed for 460 psi but operating at 175 new stoker-fired boiler will meet future high-pressure needs in large Canadian mill***

▶ CHAUDIERE FALLS on the Ottawa River between Ottawa, Ont., and Hull, Que., drops 38 ft and has an average flow of about 41,000 cfs. Early in Canada's development this water power attracted large industries, particularly lumber, pulp and paper. One of these, the E B Eddy Co, Ltd, has operated here for 90 years. This company produces about 450 tons of high-grade paper and board per day in two plants, the Eddy mill in Hull and the Booth in Ottawa.

For the Eddy mill, part of the power is purchased, and part generated in a 15,000-hp hydroelectric plant. Steam is supplied at 175 psi from a boiler plant, which houses three stoker-fired units, each with 8190 sq ft of heating surface, and a recently installed unit of 12,000 sq ft heating surface. Two old refuse-burning boilers complete the steam-making equipment.

With the return to normal operations after the business depression, steam load increased to where additional capacity was required. Hardy S Ferguson & Co were retained as consulting engineers to develop a steam-plant expansion program for present and future requirements. In space available in the boiler plant it was decided to install a fourth unit, the largest possible while still providing room for convenient and efficient operation. Before work could be started, World War II stopped further progress on the project.

During the war a greatly increased load was carried on the three stoker-fired boilers and two old refuse-burning units. To meet these demands the stoker-fired boilers operated at their maximum continuous rating six days a week, and coal in addition to refuse was burned under the old boilers to obtain maximum rating from them. As a result the overall fuel-burning economy suffered, particularly because of the old boilers' low efficiency at high ratings. Also all maintenance had to be performed during the 24-hr weekend shutdowns. By the end of 1943 load had increased to where something had to be done if the mill was to meet the demands for its products. The Canadian government therefore permitted the company to buy a new high-pressure boiler with underfeed stoker.

Problems of selecting this boiler resolved themselves into determining: (1) whether it would be economical to generate power eventually in backpressure turbines (2) most economical firing method and fuel (3) size of the steam-generating unit.

A pulp and paper mill uses large quantities of medium-pressure steam (130 psi) in digesters for cooking wood, and low-pressure steam (35 to 45 psi) for paper-machine drying rolls. These steam requirements under favorable conditions provide opportunity for installing high-pressure boilers and generating the mill's power by turbines that are bled or exhausted at pressures required for cooking, drying and heating.

About 60% of the power for this mill's operations is supplied from the company's hydroelectric plant. Using steam to generate power that can be supplied by the waterpower plant cannot be justified

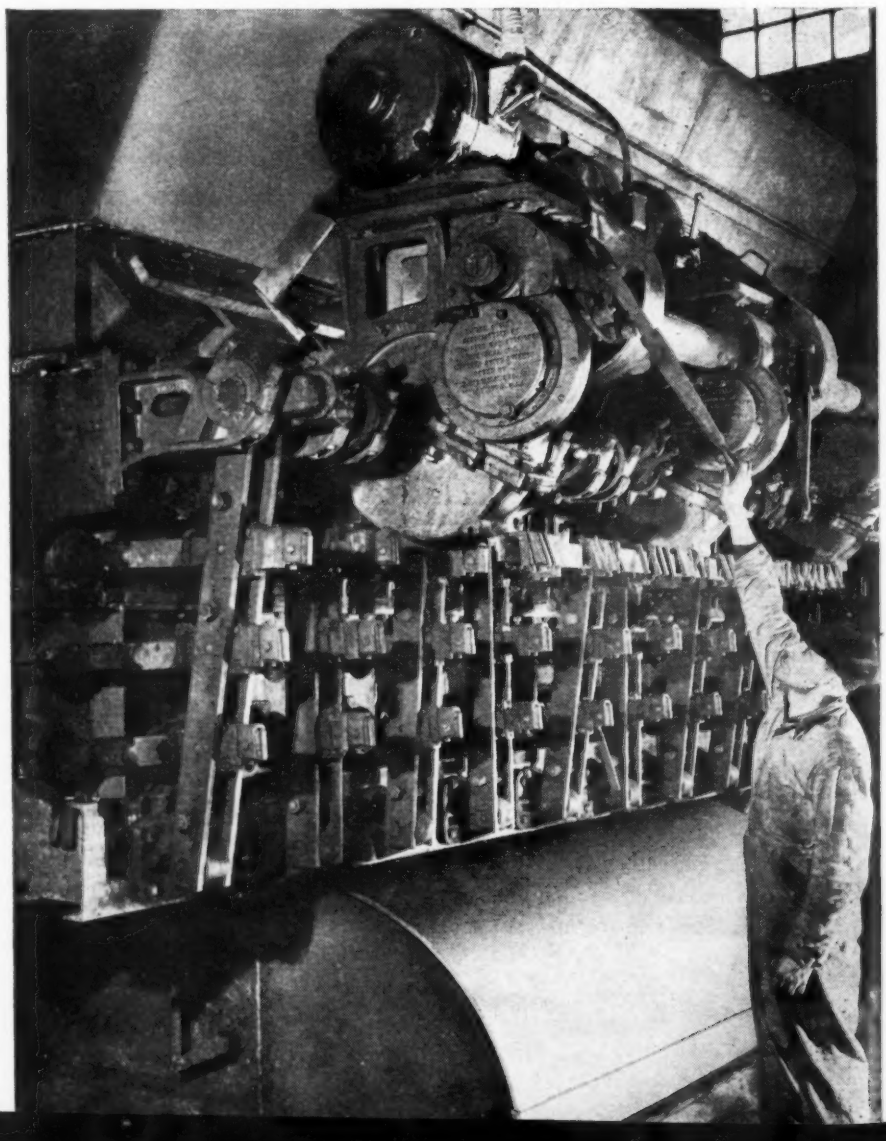


**Fig. 1—Underfeed watercooled stoker, with 286 sq ft of projected grate area and combustion rate of 10,400 lb coal per hr, is driven by 4-speed motor or by constant-speed motor and variable-speed drive. It has ten retorts with 45 tuyeres each and an extension grate that has an automatic timed-sequence clinker dump**

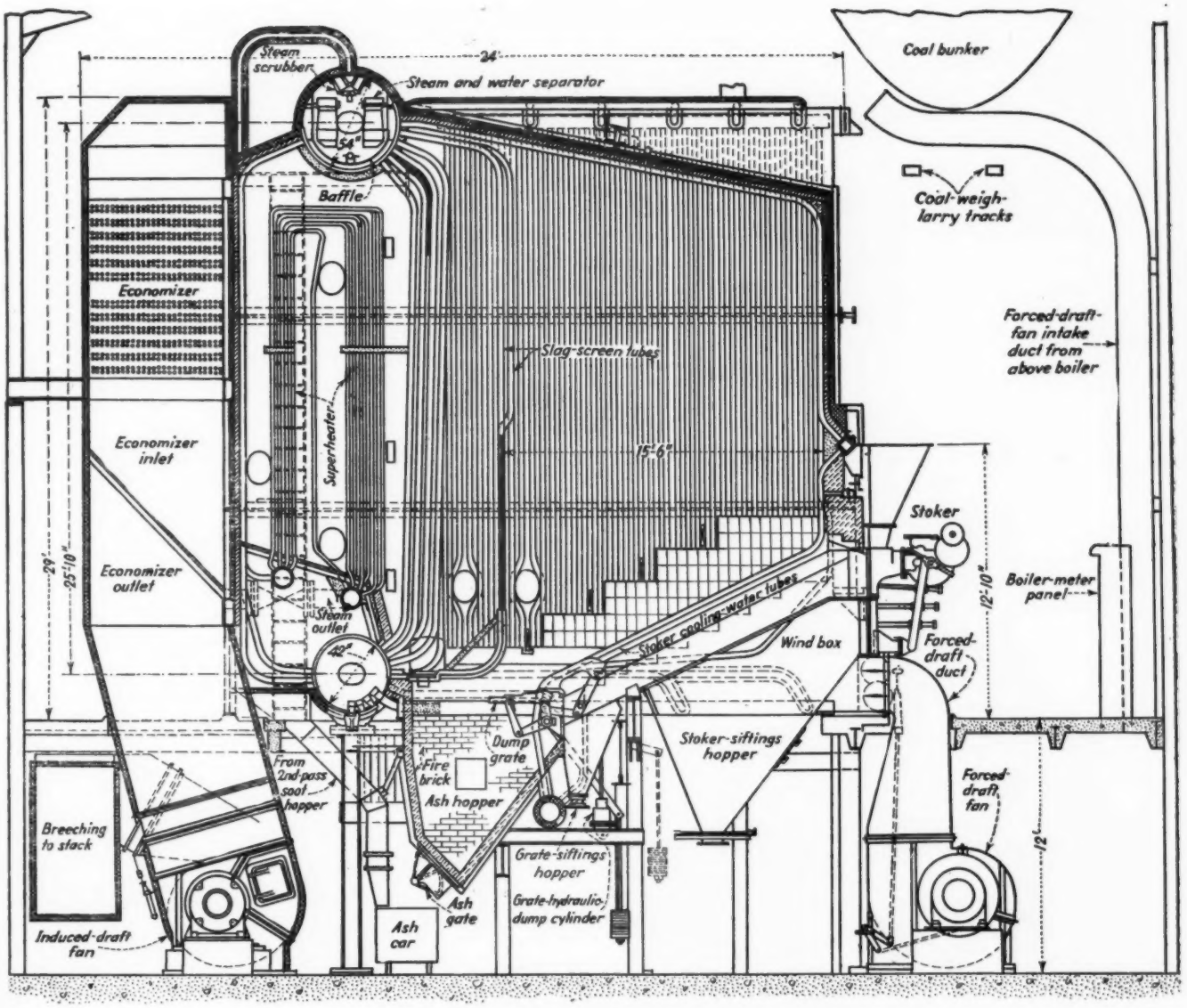



**Fig. 2—Integral-furnace boiler, of maximum capacity that could be installed in the available space, has 12,297 sq ft of heating surface in the boiler and water-walls, and 3720 sq ft in the economizer. Designed for 460-psi working pressure it operates at 175 psi and 508-F total steam temperature, present plant conditions**

under any consideration. Purchased power for the remainder of the load is obtained at a rate that under present conditions leaves little in favor of generating it in backpressure turbines. However, because these conditions may change it was decided to provide for them by installing a high-pressure boiler. If it becomes economical to generate power, or changes in mill operation require driving the paper machines by steam turbines, this can be done at no additional expense except that for turbines and other power equipment.

Another factor favoring installation of a high-pressure boiler and operating it at medium pressure is that it costs only about 5% more than a medium-pressure unit. This is true because in the initial installation only the high-pressure parts of the steam generator, such as drums, headers and tubes have to be built for high-pressure operation in the future.

Therefore, a boiler designed for 460 psi was installed to operate at 175 psi and 130-F superheat, the operating conditions of the three older boilers. Space is provided in the superheater to add tubes for 600-F total steam temperature if it becomes desirable to operate at high pressure.

High freight rates limited the fuel to a high-grade Nova Scotia or U. S. coal. Either could be burned with equal efficiency on an underfeed stoker, or pulverized. An underfeed stoker was selected because the three older boilers, which have this design, have operated satisfactorily for nearly 20 years. The plant operators being thoroughly familiar with these stokers could readily take over the new boiler with little additional training.

The new unit would operate on base load to which a stoker is well suited. Also, the plant was laid out for stoker firing, with coal bunkers and weigh larry running down the aisle in front of the space where the new boiler would be placed. Installation of both pulverized-coal equipment and a boiler of the size selected would have made it difficult to obtain a convenient operating arrangement in the space available. Disposal of furnace rejections from pulverized-coal firing would have required new ash-handling equipment, whereas that in use on the older stoker-fired boilers could serve the new unit.

Space limited the number of boilers to one, but in it was installed maximum capacity consistent with simple and convenient operation. The boiler selected

has a continuous rating of 100,000 lb of steam per hr and is a 2-drum integral-furnace design having 12,297 sq ft of boiler and waterwall heating surface, and 3720 sq ft in an economizer, Fig. 2. Furnace walls are bare with stud tubes except along the stoker fuel bed where Bailey blocks give protection against erosion.

A slag screen consisting of two rows of radiant tubes protects the boiler and superheater tubes, Fig. 2 and 3. Slag-screen tubes are staggered and spaced on wider centers than those directly behind them to cool molten slag without permitting it to bridge across and restrict gas flow. Slag and cinders from the slag screen fall on the stoker's rear end where combustion is completed before they are dumped to the ash hopper.

Two longitudinal baffles, Fig. 3, direct the gas flow through the boiler. In the first pass the gas goes first through a bank of boiler tubes, the superheater and to the rear boiler wall. It then turns and flows toward the furnace to a baffle in the front row of boiler tubes, where it turns and flows back to the rear wall. After making two passes through the horizontal-tube economizer at the boiler's rear the gas goes to the induced-draft fan and stack breeching.

### *Self-Draining Superheater*

To make the superheater self-draining its tubes are nearly vertical, with their inlet and outlet headers at the bottom. It is located in the first pass behind the slag screen and three rows of boiler tubes where it is free from slag deposits, but where gas temperatures are high enough to give the desired steam temperature.

The boiler's drum has steam-and-water separators and steam scrubbers. Steam and water from the risers enter the drum behind a semicircular baffle and from there go tangentially through cylindrical separators. Centrifugal force acting on the mixture whirling around inside the cylinders separates water and steam. The latter flows up and outward through corrugated plates, where moisture removed from the steam returns to the cylinders and goes downward to mix with water in the drum. From the drum steam goes through scrubber before entering the outlet pipes.

An air heater was not installed because of space limitations. Moreover, the high-temperature combustion air would probably have increased stoker maintenance. Also the high boiler-and-furnace efficiency guaranteed with an economizer did not encourage installation of an air heater. However, combustion air is taken from above the boiler where it is the hottest. This not only gives a small increase in boiler efficiency but also improves boiler-room ventilation.

Manufacturing processes normally operate 24 hours, six days per week with light load over weekends. Because of the high efficiency expected of the new boiler it was to be kept in operation continuously except when shut down for inspection, cleaning and maintenance. Consequently high reliability and minimum maintenance were prime considerations when selecting boiler and combustion equipment.

The watercooled underfeed stoker has ten retorts, with 45 tuyeres each, and extension dump grates. An automatic hydraulic sequence dump can be set for a definite schedule of dumping ashes and clinkers. For example, normal schedule is to dump for three minutes and then return the grates to horizontal operating position for 13 min. But any

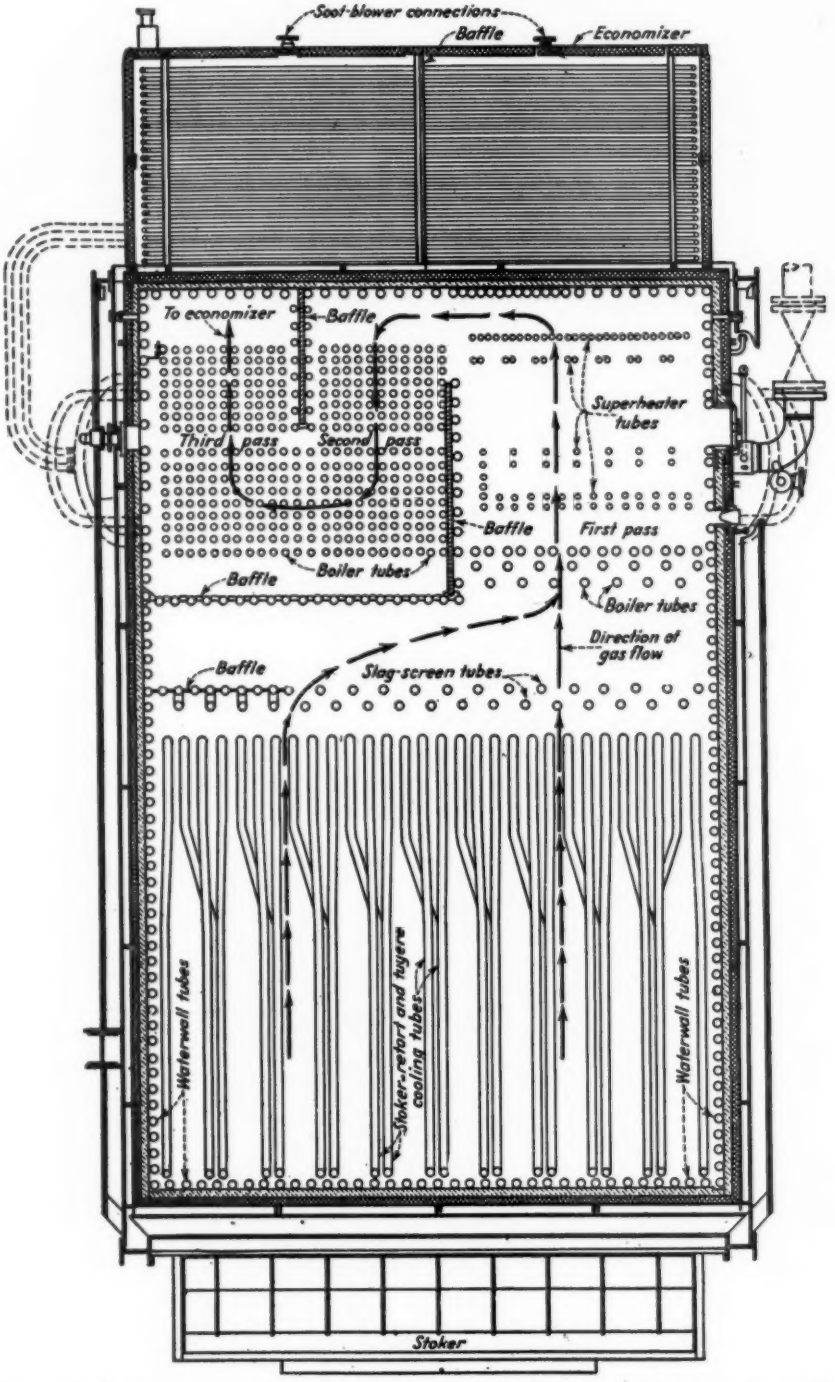



**Fig. 3—Horizontal cross-section of the boiler, Fig. 2, looking down on the water-cooled stoker. Slag screen installed in front of the boiler and superheater tubes, which are longitudinally baffled for three passes. Through the boiler, gas flows at right angles to the axis of the tubes, as indicated by the long heavy arrows**

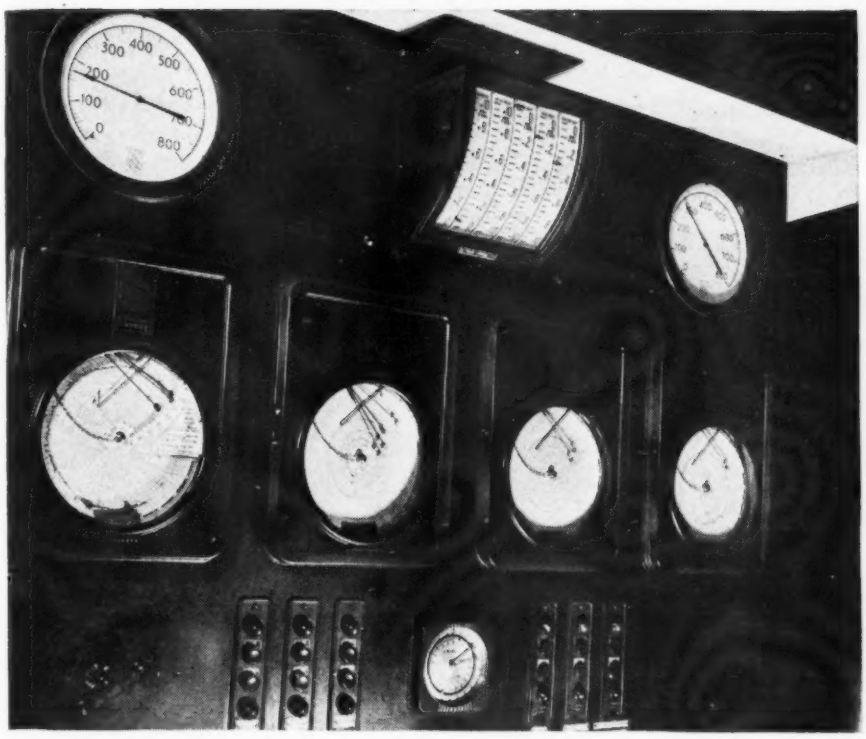


**Fig. 4—New boiler's meter panel on which are mounted meters for recording steam flow and air flow; steam, combustion-air, flue-gas and feedwater temperatures; indicating draft pressure at five points in furnace, boiler and economizer; and for recording feedwater level in boiler to guide operator**

other schedule can be selected on the control if desired, to suit operation.

Duplex drives are provided on the stoker, a 4-speed squirrel-cage motor and a constant-speed induction motor with a variable-speed transmission. Each connects to the stoker-drive shaft by a roller chain and sprockets. Normally the induction motor through the variable-speed transmission drives the stoker because it gives better speed control.

By using forced- and induced-draft fans on the boiler the plant's original stack has ample capacity for the increased load. These fans are driven by constant-speed motors, stoker draft being controlled manually by dampers in the stoker and extension-grate windbox connections. Furnace pressure is regulated by automatic control that positions the uptake damper between the induced-draft fan and breeching.

Outside of furnace-draft control, automatic control was not provided because normally the boiler will supply a base load of about 100,000 lb of steam per hour. However, in the boiler and its combustion equipment, provisions have been made for the installation of automatic combustion control if this becomes desirable.

About 60% of the boiler's feedwater is condensate return and 40% raw river water filtered through sand with no treatment. Condensate and makeup mix in a 300,000-lb-per-hr deaerating feedwater heater, are heated to 212 F and pumped

(*Continued on page* 138)

## PRINCIPAL STEAM AND ELECTRICAL EQUIPMENT

### *Boiler-Plant Extension of E B Eddy Co*

BOILER AND AUXILIARIES:

Boiler ..... Babcock-Wilcox & Goldie-McCulloch
Boiler: 2-drum bent-tube integral furnace; *waterwalls* made up of bare tubes, stud tubes and Bailey blocks; 12,297 sq ft of heating surface in boiler and waterwalls; *economizer;* 3720 sq ft of water-heating surface; rated steaming capacity 100,000 lb per hr, continuous; 460-psi design pressure, 175-psi operating pressure at superheater outlet; 5800 cu ft furnace volume; 25,000 Btu maximum heat release per cu ft per hr; *superheater;* drainable, 130-F superheat, 508-F total steam temperature
Boiler refractories ..... Babcock-Wilcox & Goldie-McCulloch
Boiler heat insulation ..... Atlas Asbestos Co
Soot blowers ..... Diamond Specialty
Ash gates ..... Link-Belt Co
Boiler steel casing, ducts, breechings .. Babcock-Wilcox & Goldie-McCulloch

COMBUSTION EQUIPMENT:

Stoker ..... American Engineering Co
Taylor, watercooled, underfeed, 17 ft, 5¾ in. wide by 16 ft, 3 in. long; 10 retorts; 45 tuyeres; actual grate area, 318 sq ft; projected grate area, 286 sq ft; combustion rate, 10,400 lb per hr
Stoker multispeed-motor drive ..... Lincoln Electric Co
Totally inclosed, 5 hp, 440 v, 450 to 1200 rpm, squirrel cage
Motor control, remote ..... Cutler-Hammer, Inc
Stoker motor on variable-speed drive ..... Canadian General Elec Co
Totally inclosed, 5 hp, 440 v, 1160 rpm, squirrel cage
Motor-starter pushbutton ..... Canadian General Electric Co
Extension-grate hydraulic dump ..... Logansport Machine Works
Extension-grate dump control ..... Eagle Sign Corp
Pump motor on grate dump ..... Canadian General Electric Co
Totally inclosed, 5 hp, 440 v, 1160 rpm, squirrel cage
Motor starter, remote pushbutton ..... Canadian General Electric Co
Safety switches on stoker motors ..... Square D Co
Furnace pressure regulator ..... A W Cash Co
Forced-draft fan, vane control ..... Sheldons, Ltd
Motor driven, 49,000 lb per hr at 5.25-in. wg and 100 F
Forced-draft fan motor ..... Canadian General Electric Co
Totally inclosed, 100 hp, 1150 rpm, 440 v, squirrel cage

### *Consulting Engineers: Hardy S Ferguson & Co*

Induced-draft fan ..... Sheldons, Ltd
One, 200,000 lb per hr, 7.4 wg at 425 F
Induced-draft fan motor ..... Canadian General Electric Co
Totally inclosed, 125 hp, 1160 rpm, 440 v, squirrel cage
Motor starters, pushbutton ..... Canadian General Electric Co
Safety switches ..... Square D Co

VALVES, PIPING AND TRAPS:

Safety valves, Consolidated ..... Manning, Maxwell & Moore
Nonreturn valves ..... Crane, Ltd
Blowdown valves ..... Edward Valves, Inc
Drain valves ..... Crane, Ltd
High-pressure valves ..... Crane Ltd
Feedwater valves ..... Edward Valves, Inc
Piping insulation ..... Insulation Products Co
Traps ..... Trevice Mfg Co

FEEDWATER SYSTEM:

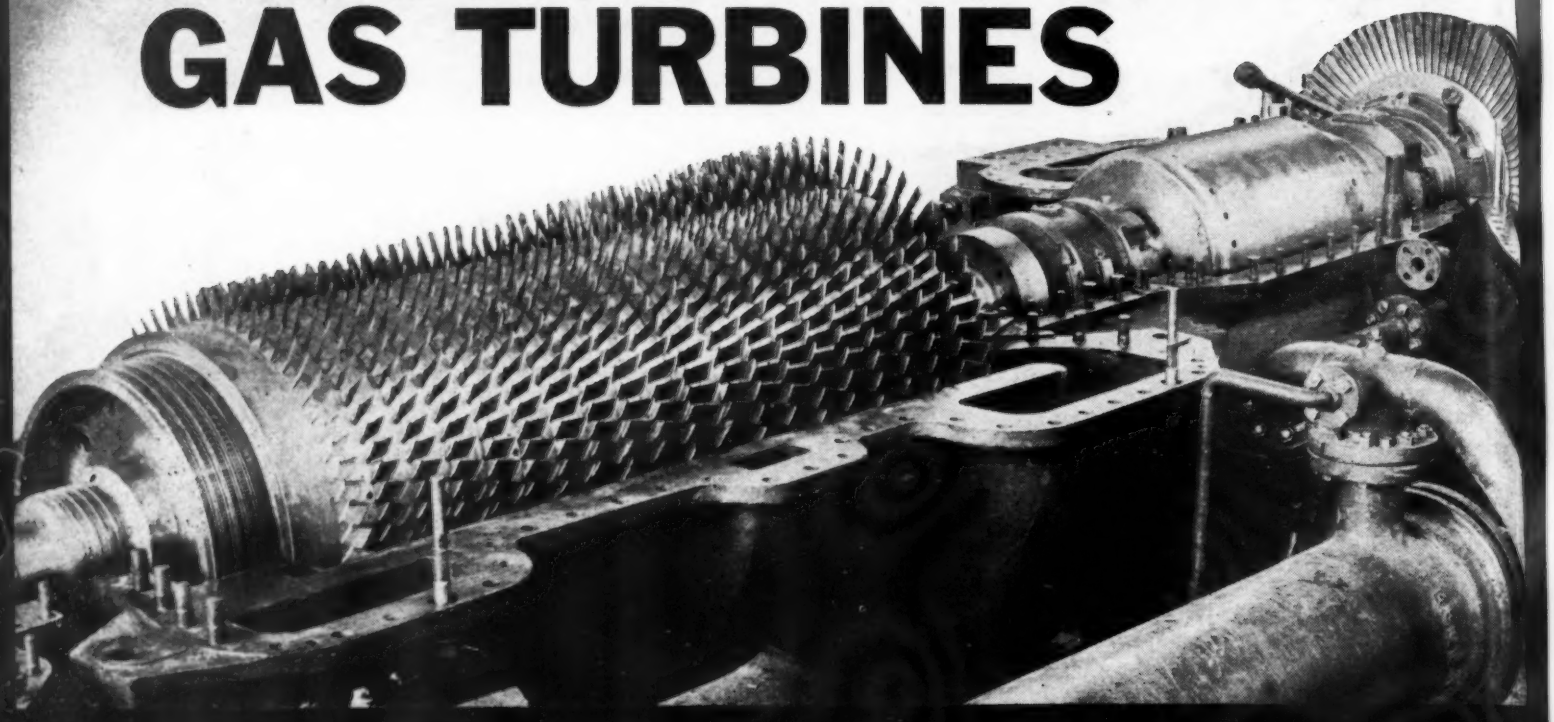
Feedwater chemists ..... W H and L D Betz Co
Feedwater acid pumps ..... Milton Roy Pump Co
Acid-feeder control ..... Canadian General Electric Co
Feedwater heater (Cochrane) ..... Canadian Allis-Chalmers
Deaerating, 300,000 lb per hr, from 65 to 212 F
Feedwater automatic controls (Copes) ..... Peacock Bros
Excess-pressure regulator (Copes) ..... Peacock Bros
Water columns ..... Diamond Specialty
Feed pumps, 2 ..... Babcock-Wilcox & Goldie-McCulloch
One, turbine driven, 225,000 lb per hr, 350 psi
One, motor driven, 150,000 lb per hr, 300 psi (standby)

METERS:

Boiler meter and control panel ..... Bailey Meter Co
Boiler meter (steam-flow air-flow), steam temperature and pressure recorders, flue-gas temperature recorders, 5-point draft gage and feedwater-level recorder ..... Bailey Meter Co
Steam-pressure gage ..... Manning, Maxwell & Moore
Hydraulic-pressure gage ..... U. S. Gauge Co

Progress Report on

# GAS TURBINES



**1** Design and testing of an experimental 1500-F 3500-hp gas turbine

**2** Development of free-piston compressor units and semiclosed cycle

## Experimental 1500-F Unit at Annapolis Yields Valuable High-Temperature Data

***Development and testing of a 3500-hp gas turbine operating at highest temperature a long-life unit has yet reached. Described by W B Tucker, Allis-Chalmers Mfg Co; Dr J T Rettaliata, Illinois Institute of Technology; Lt Comdr C F Kottcamp, USNR***

▶ RECOGNIZING THE NEED for a full-scale gas-turbine unit capable of testing high-temperature materials under actual service conditions, the Bureau of Ships, USN, arranged in 1940 for Allis-Chalmers Mfg Co to design and construct an experimental gas turbine to operate at temperatures up to 1500 F at which it will develop 3500 hp. It was installed at the U. S. Naval Engineering Experiment Station, Annapolis, Md., in 1944, but for reasons of security data on the unit have not been released until now.

The experimental gas turbine, under test about one year at progressively increasing turbine-inlet temperatures, has recently completed a series of satisfactory test runs at 1350 F, highest operating temperature ever reached in a stationary unit of this size.

Operating at fundamentally higher exhaust temperatures than steam turbines, open-cycle gas turbines require considerably higher inlet temperatures if efficiency is to be attractive. Present outlook for gas-turbine applications in the marine and power fields indicates need for ability to operate reliably at 1500 F. While much valuable data have been obtained from successful operation of gas turbines in the Houdry refining process (POWER, Aug 1945, pp 82-84) and from turbine-driven superchargers on combat aircraft, more were needed. The Houdry units, although designed for commercial long-life operation and of substantial size, operated at temperatures below 1000 F. Supercharger turbines operated at 1600 F and jet-propulsion units at 1500 F, but for military service where performance is paramount relatively short service life is acceptable. To push forward the gas turbine's commercial horizon, designers need information on operation at 1500 F of commercial long-life units of reasonable size. The Annapolis unit was built to meet this need.

To facilitate execution of the comprehensive test and research program planned for this gas-turbine plant, primary consideration was given to flexibility of operation, ease of taking test data at hundreds of points during each run, and facilities for complete disassembly

for scheduled inspections. These factors dictated arrangement of parts, Fig. 2. The cycle selected comprises one turbine driving a compressor and another driving the load, a dynamometer in this case. As shown in Fig. 1, each turbine has its own combustion chamber.

This parallel arrangement permits a wide variety of test hookups to secure data on individual components and different plant combinations. The general arrangement suits marine practice; the power turbine would drive the propeller through a suitable transmission. However, in actual application the turbines would probably be arranged in series, with reheat for higher thermal efficiency, but in this unit thermal efficiency was considered secondary to test flexibility.

Test and research program on this unit will yield (1) the first comprehensive and detailed analysis of actual gas flows, pressures and temperatures in all parts of the cycle (2) data on parasitic losses and on the effects of stratification (3) practical service experience under full-scale conditions with new high-temperature alloys (4) information on effectiveness and necessity for internal cooling (5) experience and data on thermal expansions and the mechanical provisions for them, and (6) complete information on the operating characteristics of gas-turbine power plants.

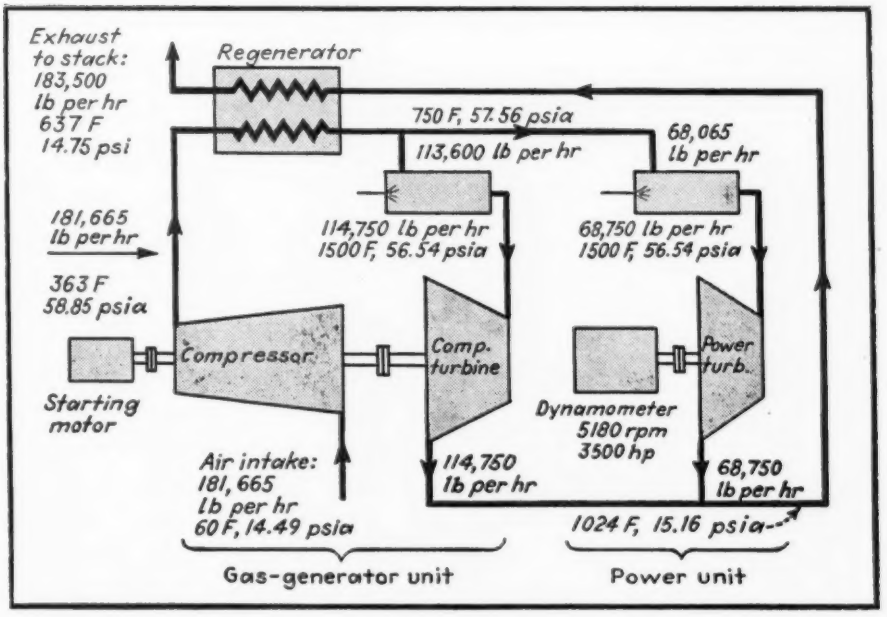

Exhaust to stack: 183,500 lb per hr 637 F 14.75 psi
Regenerator
750 F, 57.56 psia
113,600 lb per hr
68,065 lb per hr
181,665 lb per hr
114,750 lb per hr 1500 F, 56.54 psia
68,750 lb per hr 1500 F, 56.54 psia
363 F 58.85 psia
Compressor
Comp. turbine
Power turb.
Starting motor
Dynamometer 5180 rpm 3500 hp
Air intake: 181,665 lb per hr 60 F, 14.49 psia
114,750 lb per hr
68,750 lb per hr
1024 F, 15.16 psia
Gas-generator unit
Power unit

**Fig. 1—Cycle diagram shows parallel arrangement with separate turbines and combustion chambers for driving compressor and load. Flow quantities are as indicated**

Many of the problems met in designing the 3500-hp experimental unit were entirely without precedent. For example, thermal expansion required provision in combustion chambers, piping and turbines for each foot of metal to grow one-eight of an inch in all directions when heated to 1500 F and still remain pressure-tight under internal pressure of 45 psig. This movement had to be allowed without throwing any strain on the turbine casing. Provision was also made to cool bearing pedestals to prevent misalignment during high-temperature runs.

The 20-stage axial-flow compressor is rated at 40,000 cfm against the operating pressure of 45 psig. At rated output, efficiency is about 85%. Air from the compressor discharge flows to an 8500-sq-ft counterflow regenerator, which has an

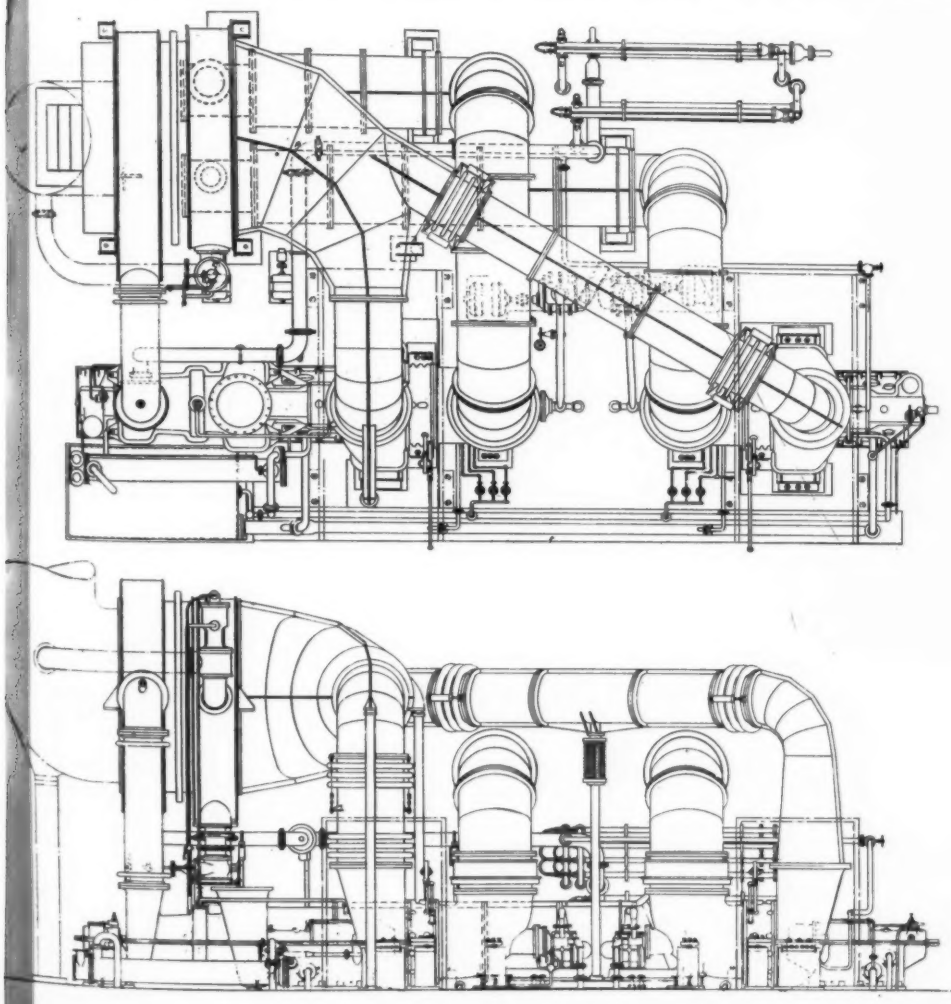
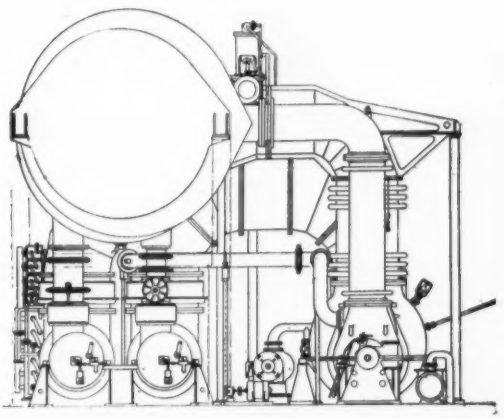


**Fig. 2—General layout of components was dictated by need of easy access for testing and inspection. Starting motor, compressor, turbines and dynamometer on same center line; combustion chambers at one side with regenerator above. Diagram indicates relative size**





effectiveness of approximately 60% with relatively low-pressure drops on air and gas sides. To facilitate removing any possible gas-side deposits, hot gas flows inside the tubes and high-pressure air on the outside. Regenerator and combustion chambers stand some distance from the unit to give easy access to turbines and compressor for the many scheduled inspections. In actual shipboard installation, regenerator and combustion chambers would go above propulsion turbines resulting in a considerably more compact plant than this experimental one.

### *High Furnace Heat Release*

A single mechanical-atomizing oil burner fires each of the two combustion chambers. Air needed to support and complete combustion passes through a central flame tube. Additional air flows between flame tube and outer chamber wall, holding flame-tube temperature to a safe level. Cooling air and combustion gas mix intimately as the concentric streams, whirling in opposite directions, come together at the flame-tube end. Full-load heat release is about 2,500,000 Btu per cu ft per hr, many times that in conventional boiler furnaces.

Present unit burns No. 2 furnace oil, adopted because it is readily available at the Experiment Station. An actual installation would use bunker C in all probability. Future plans for land installations contemplate burning pulverized bituminous coal as well as gas or oil.

A feature of the combustion system is its extreme simplicity. Air first picks up heat in the regenerator, by exchange with the turbine exhaust gas. Burning fuel directly in the air stream completes the heating. All-metal combustion-chamber design gives quick response to load changes, which are met by manually opening or closing two fuel valves. In a service installation, fuel control may be reduced to a single valve, manually operated or automatically responsive to load or speed. Fuel-spray nozzles give complete atomization over a wide range.

The gas turbine that drives the axial-flow compressor while substantially the same as the one that drives the dynamometer has somewhat longer blades and an air-operated internal bypass that is opened when starting. Each turbine has five pressure stages. In the first two impulse stages, expansion is essentially completed in the stationary nozzle ring. Thus a substantial temperature drop occurs in the fixed-nozzle structure where stresses are not severe. A diaphragm carries the nozzles that separate first and second impulse stages. Last three stages are conventional reaction.

The cross-section, Fig. 3, shows how the face of the high-temperature wheel is cooled. A double-wall pipe, passing through the inlet connection on the machine center line, carries air in the outer tube to a disk ahead of the first-stage wheel. A series of holes in the disk's periphery direct cooling air to the side of the first wheel; grooves on the wheel face increase radiation surface and the air flows radially inward over the disk surface, and out through the center of the double-wall pipe. A watercooled heat exchanger restores the air to original temperature and a positive-pressure blower returns it to the outer cooling-air pipe. This arrangement insures effective cooling without power loss, which would otherwise result from pumping air directly from atmosphere to first-stage pressure.

Cooling air is also introduced around the periphery of the second-stage diaphragm. Through radial holes it enters an annular passage around the center portion of the diaphragm and then passes through a series of holes that direct it against the downstream side of the first-stage wheel. Cooling-air supply about equals leakage of the diaphragm labyrinth seal; this air enters the gas stream and goes through the remainder of the cycle.

Turbine blades and disks are built of a recently developed Timken high-temperature alloy, which includes 16% chromium, 25% nickel and 6% molybdenum. Heavy stationary parts subject to high temperatures are of another alloy, containing 25% chromium and 12% nickel.

### *Gas-Turbine Equipment*

Both turbines and compressor have sleeve bearings with pressure lubrication, oil being cooled and cleaned continuously. Turbine equipment includes emergency overspeed and over-temperature trips, which automatically shut off fuel and open an atmospheric-relief valve in the high-pressure air line ahead of the combustion chambers.

The enormous quantities of air and hot gas circulating in a 3500-hp gas-turbine plant require large pipes. In spite of

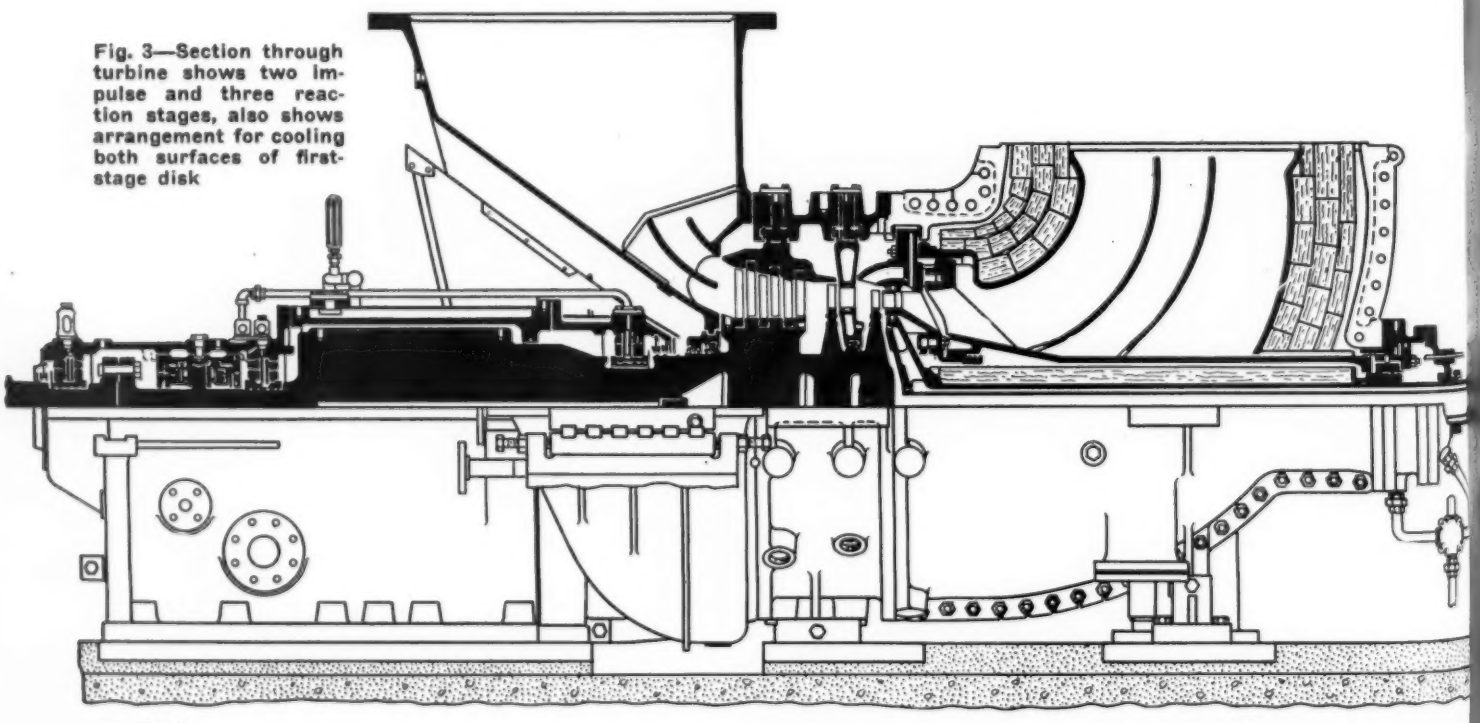


**Fig. 3—Section through turbine shows two impulse and three reaction stages, also shows arrangement for cooling both surfaces of first-stage disk**

rather high gas velocity, the Annapolis unit's air intake has 36-in. ID and the exhaust opening of the compressor turbine 42-in. ID. The large high-temperature piping is double-walled; about 9 in. of mineral block insulation separates an internal gas-guiding tube from the outer wall. There is no pressure differential across the high-temperature inner wall; temperature drop across the insulation keeps outer-wall temperature low enough so the metal's full physical strength is available.

### *Special Expansion Joints*

Thermal expansion in piping is absorbed by special expansion joints consisting of a series of radially placed hinges between the flanges. This arrangement permits rotation of adjoining members, which operate to relieve piping dimensional changes without distortion of turbine and compressor structures. Piping supports are also designed to permit thermal expansion without allowing forces to affect interconnected elements.

An electric motor clutched to the compressor brings the unit up to starting speed, about 25-35% of full-load speed. It takes less than 100 hp for starting. When firing speed is reached and fuel is ignited in the combustion chambers, the operator disengages the starting motor and brings unit up to full speed by manual fuel control.

Because of the vast number of possible test combinations of the Annapolis unit, setting up the instrumentation and test schedules imposed a tremendous task. Gas-turbine engineers of the Engineering Experiment Station, in conjunction with Bureau of Ships engineers, worked out a thorough and comprehensive program.

### *Maintenance Checks*

Test plans include operating the unit for various periods under prearranged conditions, with gradually increasing inlet temperatures. Complete disassembly and inspection follows each test period; numerous measurements determine changes in high-temperature parts. Inspection includes thorough search for possible cracks, distortion of parts and observation of resistance to oxidation.

The 2-shaft arrangement makes it possible to operate compressor and power turbines at different speeds, pressure ratios and gas-flow rates, thus permitting determination of compressor and turbine characteristics over a wide range. A throttle valve in the high-pressure air line just ahead of the power-turbine combustion chamber permits separate load and speed regulation.

First complete test runs began with compressor at 40% of full speed, followed by gradual increases to full speed with compressor-turbine inlet temperature up to 1050 F. Making complete tests at each new level, temperature was raised in steps until recently the power turbine operated at full speed and 1350 F. According to present schedule the unit will be tested at 1500 F by late summer.

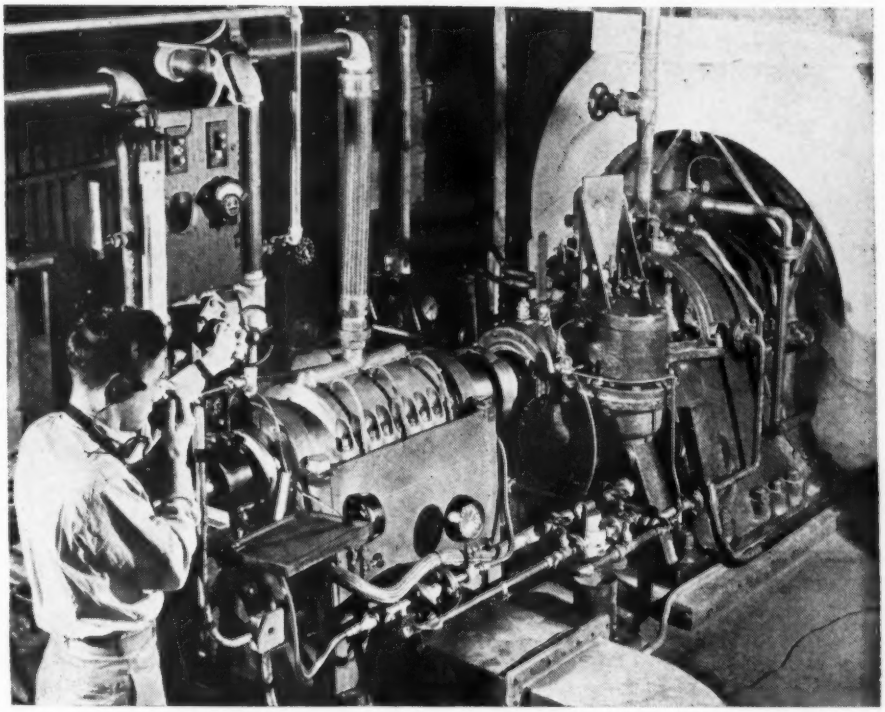


**Fig. 4—Dynamometer equipment at output shaft of power turbine gives some idea of comprehensive instrumentation used in testing experimental high-temperature unit**

Establishing instrumentation, procedure and calculating methods for such a comprehensive test program is an enormous undertaking. As tests progressed both methods and equipment were improved. As now set up, a smooth-working procedure coordinates recording of data on pressures, temperatures, flows, speeds and power at many stations and for each test condition; such data cover not only air and gas flowing through main units but fuel oil, lubricating oil and internal cooling air as well. Calculation of results is another major undertaking, but to simplify the work Navy engineers have contrived many tables, charts and calculation procedures. Many of these have been published for use by gas-turbine engineers (POWER, March 1946, p. 134).

### *Tests Prove Expectations*

Although occasional minor difficulties developed during testing, they were all overcome and the unit is delivering its expected performance. In the more than 500 hours of operation under the rigorous test schedule, much new data have been obtained, particularly in regard to axial-flow compressor characteristics over a wide operating range. Eventually a complete report of the project will be published when the long-term test program has been completed.

Based on data obtained from tests on this high-temperature unit, it is estimated that over-all plant thermal efficiency of 40% at 1500 F could be obtained with a modified marine plant of this size. In the modified plant, the compressor would be in two sections, intercooled, and the turbines would be in series, with reheating. For a future top-efficiency installation, regenerator surface would be several times that of the Annapolis unit. Gas turbines of this type can be applied to marine propulsion with what is expected to be lower weight per horsepower and smaller space occupancy than now obtained with other classes of equipment. Such a gas-turbine power plant might make use of an electric transmission, but reversible-pitch propellers and other methods offer attractive possibilities to deliver power for ahead or astern operation.

There is thus evidence that gas-turbine plants can be built that will give a good account of themselves in marine practice, but little service experience is available on long-time operation of multistage high-temperature high-efficiency gas turbines. Test and research program of the Annapolis experimental unit will go a long way toward supplying this need.

# Free-Piston Compressor Work Leads To New Semiclosed Cycle Development

***Results of ten years' research in high supercharging of diesel cylinders, free-piston compressors and gas turbines at Sulzer Bros, Winterthur, Switzerland, told to British engineers and shipbuilders by J Calderwood*. New semiclosed cycle described***

By S A TUCKER
*McGraw-Hill World News*

▶ SOME TEN YEARS AGO Sulzer Bros began to aim its research program at the most promising fields of application of exhaust turbines used in conjunction with reciprocating machines, as well as continuous-combustion gas turbines. Three main lines were followed: (1) highly supercharged reciprocating engines with exhaust turbines**, POWER, Dec 1942, pp 102-103 (2) reciprocating crankshaft and free-piston units in which substantially all the useful work is done by the exhaust turbine, POWER, Nov 1945, pp 67-68, and (3) development of a gas-turbine cycle employing heat exchangers of reasonable size and weight that would have a nearly flat efficiency curve at part loads for marine service.

As the supercharging pressure of reciprocating engines is increased above the 30 to 45 psia now commercially developed in Europe, the proportion of work done by the exhaust-gas turbine rises until at about 75 to 90 psia the engine output is just sufficient to drive the compressor, and the whole useful output is produced at the turbine shaft. Under these conditions the free-piston compressor unit proves a most satisfactory machine for producing the power gas. The compression ratio is automatically variable so the compressor can be started at low cylinder pressure, a considerable advantage over highly supercharged crankshaft engines.

Whether or not the free-piston compressor plant is ever developed on a large scale commercially, it affords a useful stage in the general progress toward a true combustion-turbine cycle. A great deal of valuable experience in gas-turbine design has already been obtained from the experimental machines so far constructed.

Early tests on a crankshaft engine of about 5½-in. bore at a bmep of 255 psi yielded specific outputs three times that of unsupercharged 2-stroke cylinders. A 10-in. free-piston unit with 2 x 22-in. stroke gave a power-gas production equivalent to 475 bhp at 280 cycles per min at 75 psia and 930 F. Assuming an 85% turbine engine efficiency, fuel consumption of the order of 0.38 lb per bhphr was established for this unit.

With precompression of the charging air, size and weight of the reciprocating machine for a given net output are further reduced, or alternately the power output for a given cylinder is increased, so the 16-in.-bore 2 x 24-in.-stroke cylinder of Fig. 1 supercharged to 27 psia gives a power-gas output at 350 cycles per min of over 2000hp. Three such units, Fig. 3, and their associated auxiliaries constitute a complete experimental power plant of over 6000 hp, which has been tested extensively at Winterthur.

While the power-gas cycle offers efficiencies comparable with usual diesel engines, the disadvantages of reciprocating machinery remain. For this reason development of a combustion-gas turbine without reciprocating parts has proceeded in parallel with the foregoing research on the power-gas cycle.

### *Semiclosed-Cycle Development*

Several possible arrangements of the combustion cycle have been investigated with three objectives: (1) to obtain full-load efficiency substantially better than that of modern steam turbines (2) to develop a marine-propulsion unit of substantially constant efficiency at part loads and reduced speeds when geared to a propeller (3) to achieve the maximum in compactness for marine service.

For the second of these objectives it is essential that the quantity of air flow be reduced for part loads. Best efficiencies are realized if operating temperature remains constant as load varies.

The semiclosed combustion-turbine cycle now under investigation, Fig. 5, has many points of similarity to the power-gas

* Paper by J Calderwood, presented before North-East Coast Institution of Engineers and Shipbuilders, April 5, 1946, is condensed in this article.

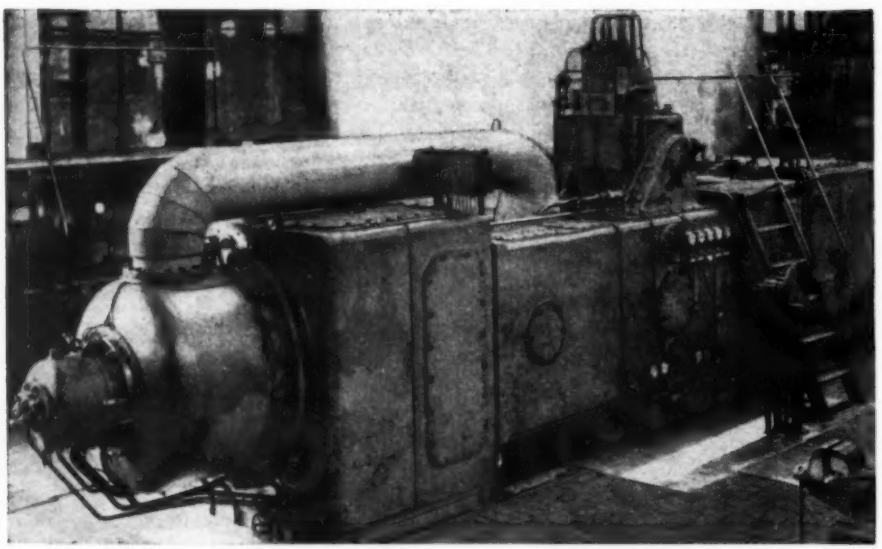


**Fig. 1—Experimental free-piston compressor having about 16-in. bore and 24-in. stroke. Precharged to about 27 psia, the cylinder produces sufficient power-gas output at 350 cycles per minute to deliver more than 2000 hp at exhaust turbine**

** Details of highly supercharged reciprocating engines will appear in June 1946 issue of POWER.

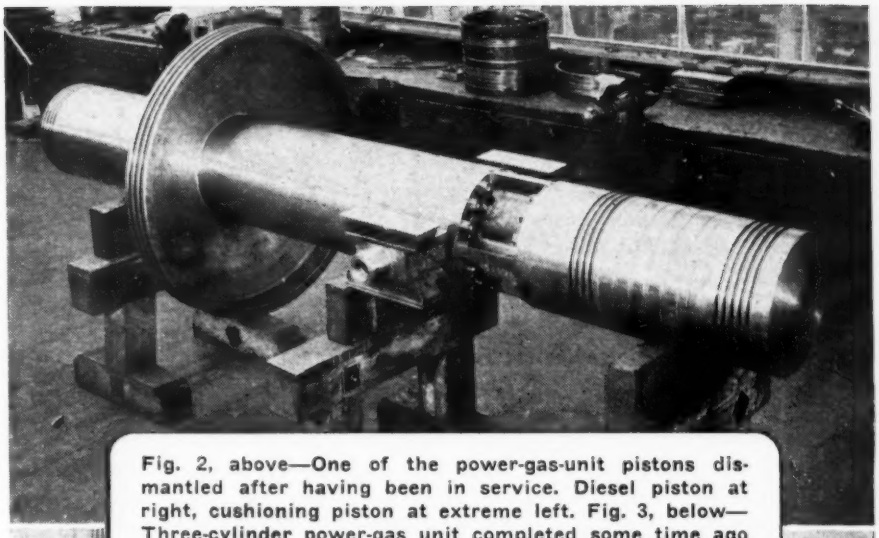
cycle, except that reciprocating machinery is supplanted with rotary equivalents. The two lines of development have progressed more or less simultaneously, work on one having undoubtedly influenced that on the other.

Most of the elements are grouped in what may be considered in principle a closed cycle, with the supercharging compressor, output gas turbine and combustion chamber in a sense external to the inner-flow circuit. Enough air enters the unit through the supercharging compressor to generate the required output in later expanding (at full load) from 240 psia and 1200 F to atmosphere in the output turbine.

### *Semiclosed-Cycle Operation*

Air enters the inner circuit at 60 psia just ahead of the precooler, joining with the main flow of air returned from the regenerative heat exchanger. Total flow is compressed to 240 psia in two stages with intercooling provided. After compression the air is heated in a regenerator to the highest temperature economically practicable and divided automatically into two streams. One part is led to the combustion chamber, heated to a high temperature by direct combustion of oil, cooled to about 1200 F in a separate heat exchanger and passed to the output turbine at about 240 psia. Remainder of air flow is heated to 1200 F by transfer through the tubes of the heat exchanger and then expanded in a turbine to 60 psia to drive the three compressor stages.

Only relatively clean air circulates within the inner circuit, the products of combustion passing through only one



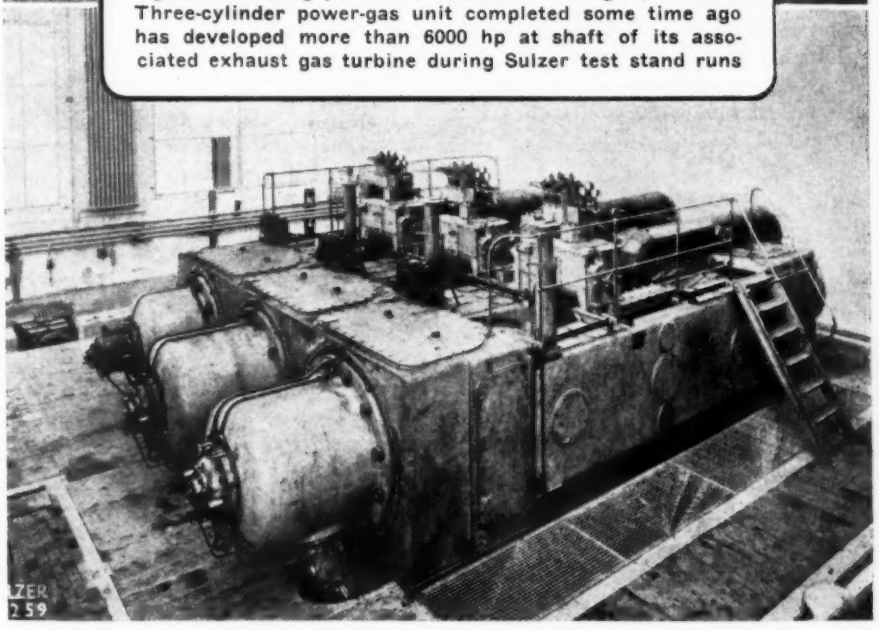


Fig. 2, above—One of the power-gas-unit pistons dismantled after having been in service. Diesel piston at right, cushioning piston at extreme left. Fig. 3, below—Three-cylinder power-gas unit completed some time ago has developed more than 6000 hp at shaft of its associated exhaust gas turbine during Sulzer test stand runs

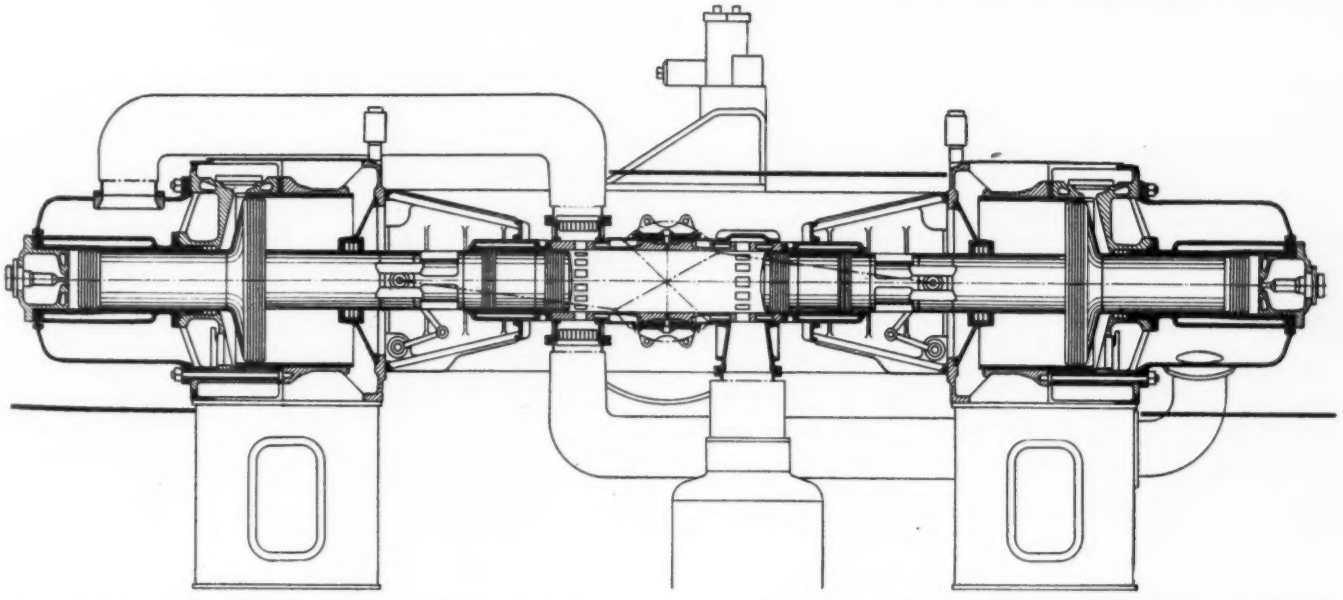


Fig. 4—Free-piston compressor cross-section indicates arrangement of supercharged opposed-piston diesel cylinder, solidly connected compressor pistons, cushioning chambers at extreme ends and connecting linkage. Axial-flow compressor discharges to piston-compressor suction; high-pressure air charges diesel cylinder through piping shown

heat exchanger and the output turbine. The sole parts subjected to very high temperature are the combustion chamber itself and the heat exchanger. The pressure difference between inside and outside passages of the high-temperature heat exchanger is negligible.

All the foregoing pressures and temperatures are stated for full-load conditions. As less fuel is fired, temperature of air within the closed part of the cycle falls slightly, reducing the compressor-drive-turbine speed and consequently the quantity of air circulating. Reduced air flow restores equilibrium conditions at about the same temperature as at full load but with reduced pressure throughout the cycle.

For starting, the compressor is brought up to moderate speed by an electric motor. Additions of fuel in the combustion chamber result in a net excess of power available to bring the entire unit up to speed.

The turbines and compressors of this cycle represent no particularly difficult design problems; their types and dimensions are the same as for others already developed as auxiliaries for the power-gas machines and reciprocating-engine supercharging. Much research has already been devoted to materials to withstand stress at high temperatures and on the aerodynamic efficiency of blading for compressors and turbines. Much more remains to be done, however.

As a practical measure the various elements have been built and tested separately before being combined into a complete power unit. At present an output turbine with associated combustion chamber, Fig. 6, is under test at Winterthur. Fig. 7 compares the expected range of gas-turbine plant performance at various turbine-inlet temperatures with that of stationary and marine steam plants for various steam pressures and temperatures at turbine throttle.

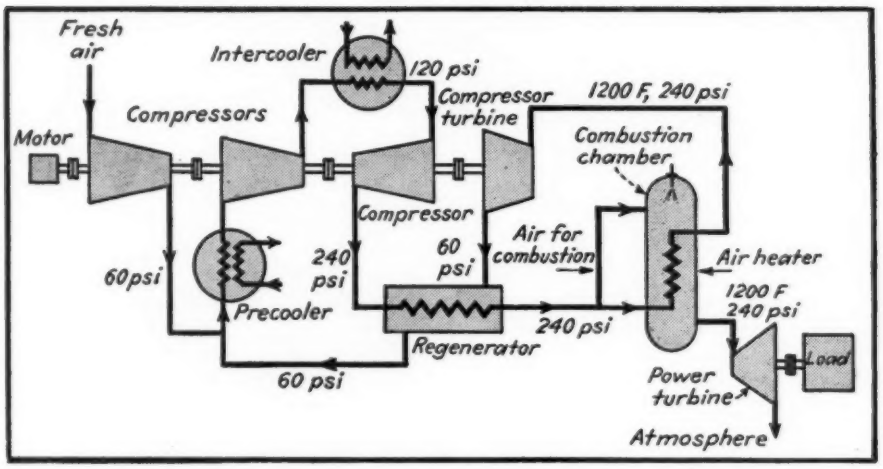



**Fig. 5—In semiclosed cycle, power-output turbine uses combustion gas generated to heat air in closed circuit. Atmospheric air compressed to 60 psia joins the circulating flow. After cooling, total flow is compressed to 120 psia, intercooled and finally raised to 240 psia. After regenerator, part of flow is heated by direct combustion of oil; it then gives up part of its heat to remaining larger portion, and leaves the cycle by expanding through the power turbine. Remaining heated air stays in closed circuit, expands through turbine driving the compressors and after passing through regenerator joins entering makeup air ahead of precooler**

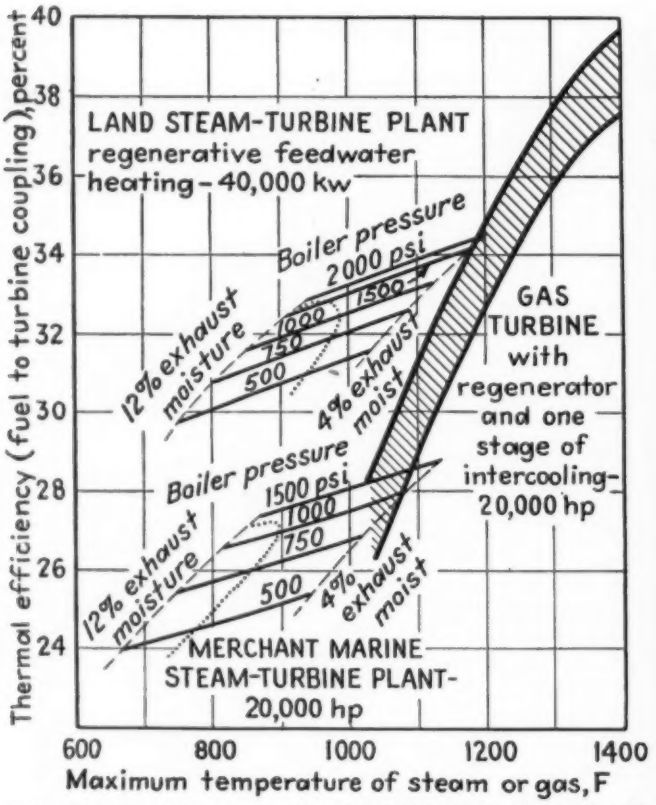



**Fig. 7—Expected range of gas-turbine-cycle thermal efficiencies compared with stationary steam plants of 40,000 kw and marine-propulsion units of 20,000 kw at various steam pressures and for given initial cycle temperatures**

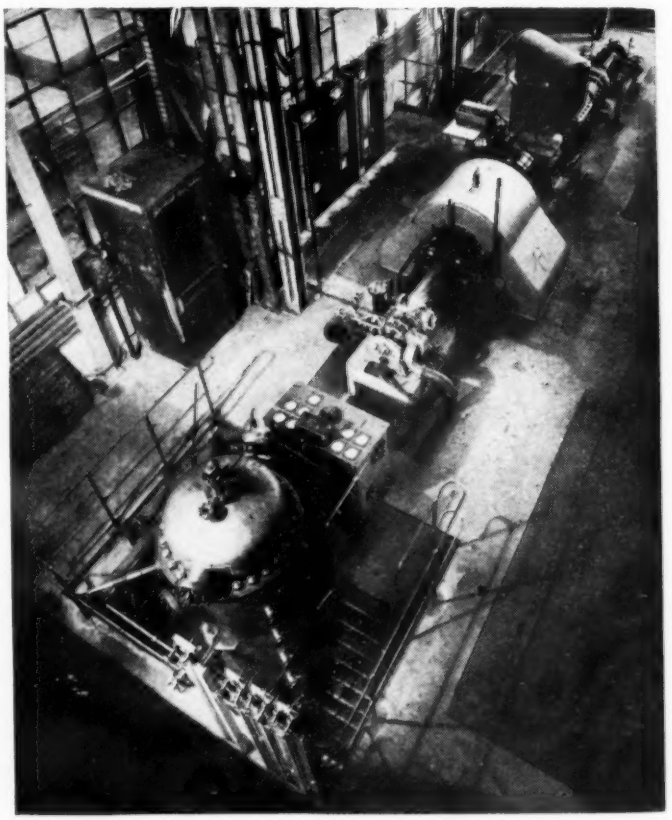


**Fig. 6—Semiclosed-cycle combustion chamber and gas turbine, built for experimental purposes, shown on test bed**

# Universal Chart Gives Speedy Answers To Problems in Fluid Flow

***Piping design depends on fluid nature and pipe interior surface. These charts speed up cut-and-try solutions and facilitate selection of size commensurate with fluid pressure loss***

By W C WOODMAN
*Stone & Webster Engineering Corp*

▶ WITH DATA that have recently become available it has been possible to prepare a universal chart for the rapid solution of problems concerning fluid flow in closed conduits or pipes. The solution takes proper account of variation in friction factor as a function of Reynolds Number and conduit-wall relative roughness.

Data in regard to friction factor as a function of Reynolds Number, having been available for several years, were incorporated in numerous charts. One of these by the author appeared in POWER, Aug 20, 1929, pp 292-3. Correlation of the friction factor to pipe-wall relative roughness is a more recent development. Relative roughness is the ratio of absolute roughness of inner-wall surface to inside diameter. Absolute roughness measurements are arbitrary in nature, being determined experimentally.

In 1933 R J S Piggott published a chart, which several textbooks have reproduced. Derived from experimental data, it delineated friction factor in terms of relative roughness. Since then as a result of mathematical research by Von Karman, Colebrook and others, a functional relationship has been developed. It enabled establishing a group of friction-factor curves covering the entire range from perfectly smooth pipes to the region of complete turbulence with rough pipes. L F Moody presented these curves in *Transactions, ASME*, Nov 1944, pp 671-684. The family of friction-factor curves, Fig. 2, is based on his paper except that the units are converted to those an engineer uses.

Fanning's equation for pressure loss,

$$h = \frac{4fV^2L}{2gd}$$

correlates pressure loss in closed conduits to the fluid quantity flowing and other variables, and is fundamentally

### Equation Symbol Legend

| | |
|---|---|
| $d$ | = pipe diameter, ft |
| $D$ | = pipe diameter, in. |
| $f$ | = friction factor: a function of both Reynolds Number = $V\rho d/z$ = $F/dz = R$ and relative roughness = $\epsilon/d$ |
| $F$ | = fluid flow, lb per hr |
| $g$ | = acceleration of gravity = 32.2 ft per sec per sec |
| $h$ | = pressure drop, ft of fluid |
| $L$ | = length of pipe, ft |
| $P$ | = fluid pressure, psf |
| $\Delta P$ | = fluid pressure drop, psi |
| $v$ | = fluid average specific volume, cu ft per lb |
| $V$ | = fluid velocity, fps |
| $z$ | = fluid viscosity, English units, lb (force)x sec/ft² |
| $\rho$ | = fluid average density, lb per cu ft |
| $\epsilon$ | = pipe-wall absolute roughness |
| $\epsilon/d$ | = pipe-wall relative roughness |
| $\phi$ | represents "function of" |

## Fluid-Flow Theory

An expression can be deduced for fluid-flow pressure drop by means of dimensional analysis as follows:

$$P_2 - P_1 = \frac{V^2\rho L}{d}\Phi\left[\frac{V\rho d}{z}, \frac{\epsilon}{d}\right]$$

This is Fanning's equation where friction factor $f$ has been replaced by some unknown function of the two parameters, Reynolds Number, $V\rho d/z$, and relative roughness, $\epsilon/d$.

The nature of this unknown function must be determined by test measurements. If values of the function $\Phi\left[\frac{V\rho d}{z}, \frac{\epsilon}{d}\right]$ are plotted against $\frac{V\rho d}{z}$ itself, a family of smooth curves should result. Colebrook's function expresses the relationship between friction factor, Reynold's Number and relative roughness, and was used by L F Moody in fairing and plotting this family of curves as presented in his paper and as reproduced with different units in Chart III of Fig. 2, p 76.

*Streamline versus Turbulent Flow.* When the dimensionless Reynolds Number is sufficiently small, individual fluid particles move in straight lines parallel to the pipe axis in a type of motion described as streamline or laminar. With higher values of Reynolds Number the flow is said to become turbulent with the development of radial velocity components. These appear in the central fluid zone and break up the straight-line motion of fluid particles, parallel to the pipe wall, producing eddies and vortices.

*Streamline Flow.* With streamline flow the pressure loss is directly proportional to the first power of the velocity. Since $V = 0$ at the pipe wall the factor $\epsilon/d$ disappears. $\Delta P$ can be proportional to $V$ only if

$$\Phi\left[\frac{V\rho d}{z}\right] = K\frac{z}{V\rho d}$$

or $$f = K/R$$

When this value of $f$ is substituted in Fanning's equation it reduces to

$$P_2 - P_1 = \frac{KVLz}{d^2}$$

Thus in this type of motion, pressure loss is proportional to the viscosity and independent of the fluid density. The friction factor is inversely proportional to the Reynolds Number and independent of surface roughness. This is illustrated in Chart III, Fig. 2, for values of Reynolds Number below 15.

*Complete Turbulence.* On the other hand in cases of extreme turbulence, as with very high values of Reynolds Number or with moderate values of Reynolds Number coupled with a very rough pipe wall, it has been observed that the pressure loss is proportional to the square of the velocity. This can be true only if

$$\Phi\left[\frac{V\rho d}{z}\right] = 0$$

or $$f = \Phi(\epsilon/d) \text{ only.}$$

Again substituting in Fanning's equation,

$$\Delta P = \frac{KV^2\rho L}{d}\Phi\left[\frac{\epsilon}{d}\right]$$

With complete turbulence the pressure drop is proportional to the fluid density and independent of its viscosity. Here the friction factor is independent of the Reynolds Number and a function of relative roughness only. In Chart III, Fig. 2, the region of complete turbulence to the right of the dotted line indicates the above relationship, and the friction-factor curves become a system of straight lines parallel to and independent of the $F/Dz$ axis.

*Transition Zone.* Between the foregoing two extremes there is a transition zone of incomplete turbulence bound by the curve for perfectly smooth pipe and the limit line for the zone of complete turbulence. Since perfectly smooth pipe must be characterized by the total absence of roughness, the factor $\epsilon/d$ disappears, and

$$f = \Phi\left[\frac{V\rho d}{z}\right] \text{only.}$$

Again the relationship of friction factor and Reynolds Number must be determined by test measurements, and the curve for smooth pipe appears in Chart III, Fig. 2. In a perfectly smooth pipe the friction factor is independent of $\epsilon/d$ and these curves merge into the smooth-pipe curve. The equation for this curve as given in Moody's paper is:

$$\frac{1}{\sqrt{f}} = 2\log_{10}\frac{R\sqrt{f}}{2.51}$$

In the transition zone between the perfectly smooth pipe and the dotted line indicating the lower limit of complete turbulence, the friction-factor curves are both asymptotic to the smooth-pipe curve and to the horizontal lines in the zone of complete turbulence. In this transition zone the curves follow the Colebrook function:

$$\frac{1}{\sqrt{f}} = -2\log\left[\frac{\epsilon/d}{3.7} + \frac{2.51}{R\sqrt{f}}\right]$$

correct if the friction factor is properly expressed as a function of the Reynolds Number and the relative roughness. Expressing this equation in more conventional engineering units, it becomes

$$P_2 - P_1 = \frac{4f\rho V^2 L}{2gd}$$

$$\text{or } \Delta P = 0.0000134\,\frac{fF^2 Le}{D^5}$$

This represents truly the relations for all fluid flow provided the pressure drop is relatively small (not over 10% of initial pressure) so changes in specific volume may be neglected. The author describes fluid-flow determinations with large pressure loss, POWER, Sept 1944, p 82.

Fig. 3 is a nomogram of the above equation. This chart alone solves many problems directly, especially after some experience has been gained with average friction factors. Average values of friction factor applying to the steam flow in different pipe sizes are indicated. Most of the axes in Fig. 3 are plotted with double scales thus simplifying mechanical labor in using the chart. As a final operation in step 4, the straight edge pivots on the $t$ axis between the $D$ and $\Delta P$ scales. By rotating the straight edge, values of $\Delta P$ can be read corresponding

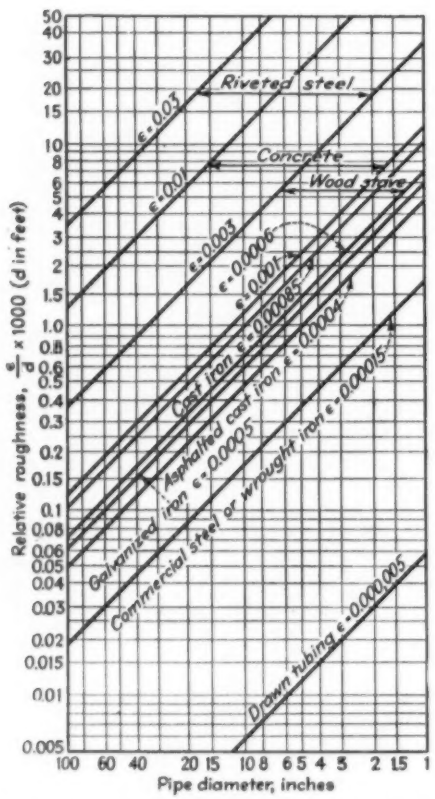



Fig. 1—Relative roughness for given type of interior pipe surface decreases with increasing pipe diameter. Scale of absolute roughness $\epsilon$ arbitrarily defined from experimental results. Curves should be regarded as center lines of rather broad bands that tend to overlap

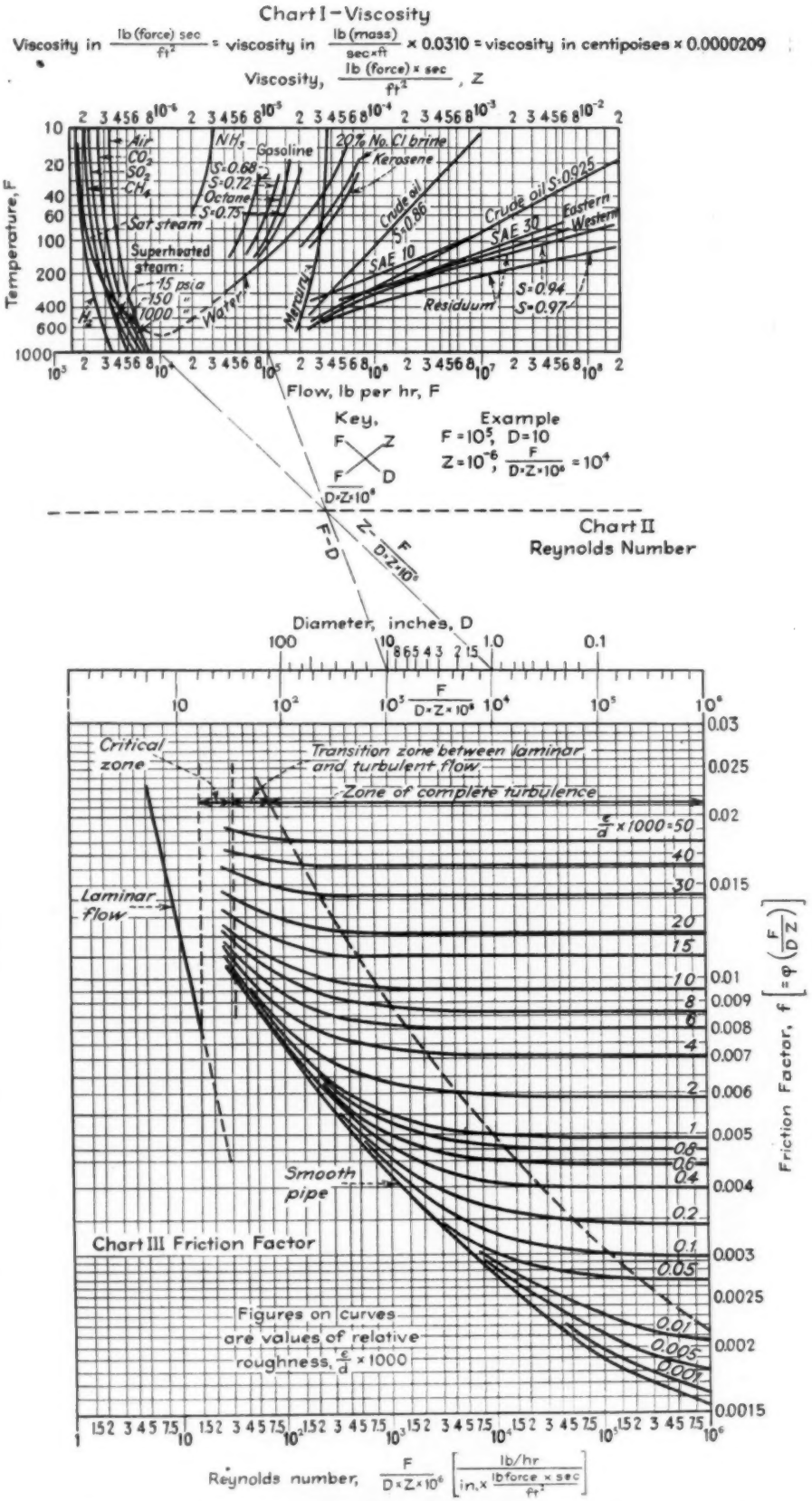



Fig. 2—Chart I relates the temperature and viscosity for various fluids. Chart II, a nomogram, calculates the Reynolds Number for the given viscosities, flows and diameters of pipes. Chart III relates the Reynolds Number and friction factor for the given values of relative roughness and shows the character of fluid flow in pipes. (Viscosity data in the charts is from R L Daugherty, in June 1934 issue of "Transactions of ASME"; friction factors from L F Moody, November 1944)

to a series of pipe diameters, and a diameter can then be selected consistent with the available pressure drop.

If more precision is needed an accurate value of friction factor may be determined from Chart III in Fig. 2 as a function of both the Reynolds Number, $F/Dz$, and the relative roughness, $\epsilon/d$. Relative roughness factor for pipes of different diameters and with different inside-surface characteristics (absolute roughness) is found from Fig. 1. Reynolds Number, the other independent variable in Chart III, can be either calculated from the problem conditions or solved by Charts I and II. Chart I gives the viscosity $z$ for a number of common fluids. Using the viscosity scale on Chart I (Note this is at the top; the lower scale applies to the nomogram Chart II only.) with chart II the Reynolds Number $F/Dz$ is directly found without a calculation ($D$ may have to be assumed initially) and with this value Chart III is entered directly since the companion charts II and III have a common Reynolds Number scale.

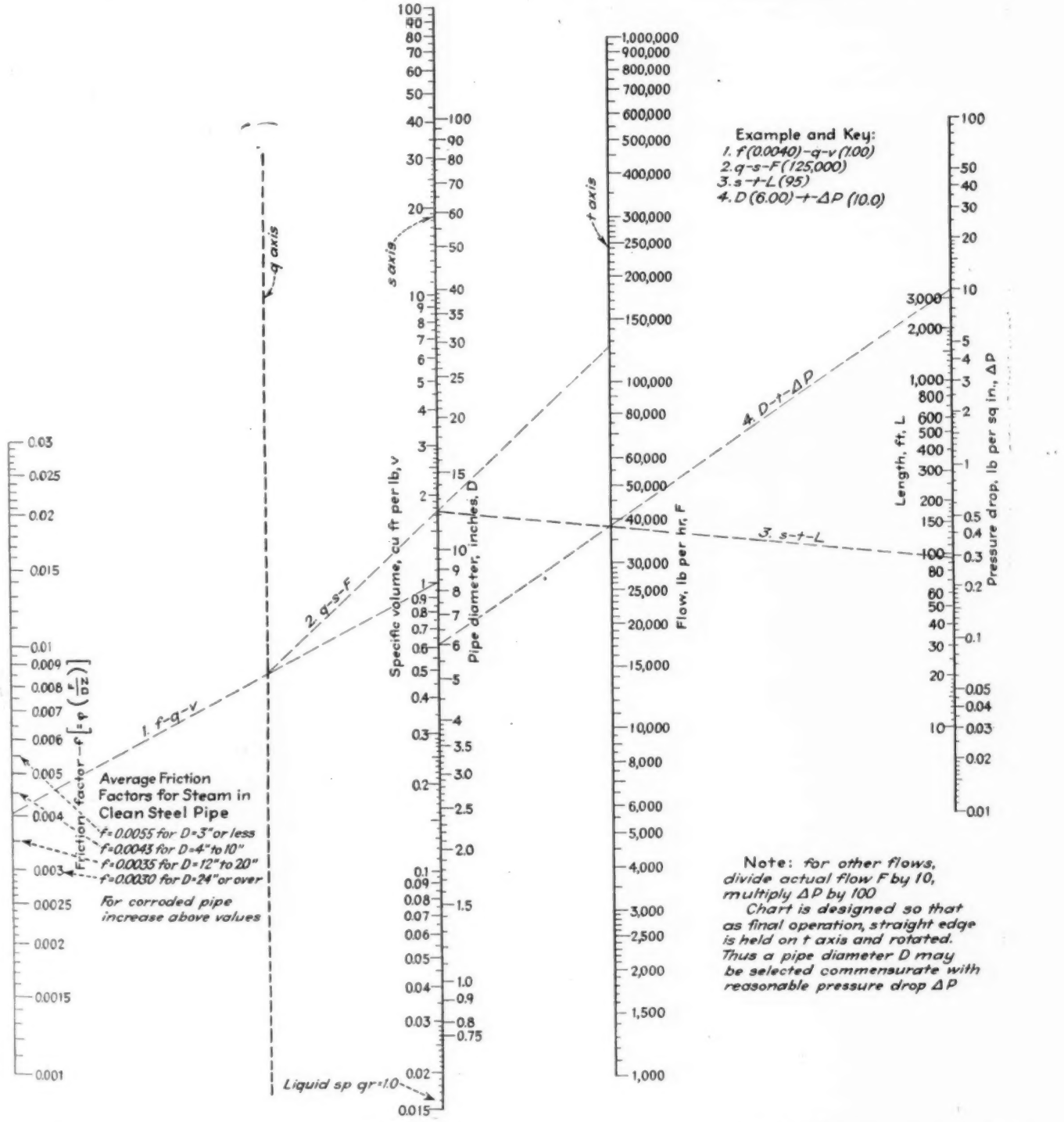
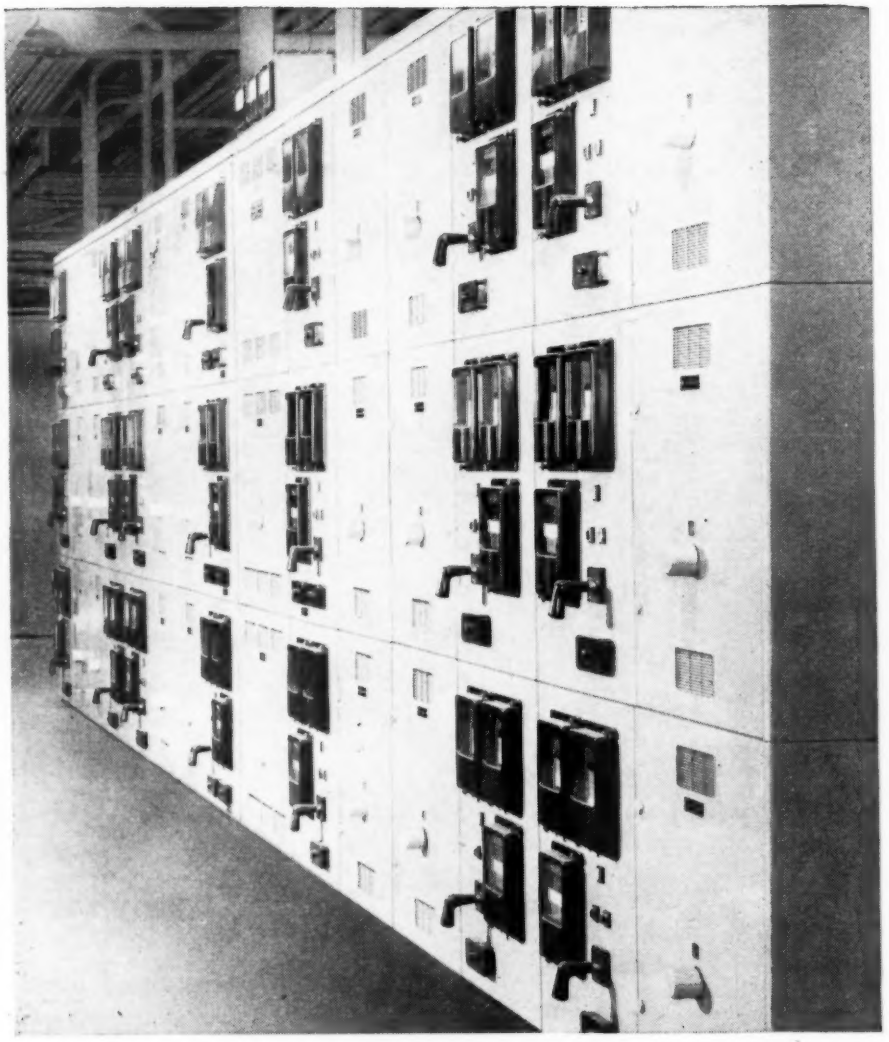

Example and Key:
1. f(0.0040)-q-v(1.00)
2. q-s-F(125,000)
3. s-t-L(95)
4. D(6.00)-t-ΔP(10.0)
q axis
s axis
t axis
1. f-q-v
2. q-s-F
3. s-t-L
4. D-t-ΔP
Friction factor = f [= φ (ε/dz)]
Average Friction Factors for Steam in Clean Steel Pipe
f=0.0055 for D=3" or less
f=0.0043 for D=4" to 10"
f=0.0035 for D=12" to 20"
f=0.0030 for D=24" or over
For corroded pipe increase above values
Liquid sp gr=1.0
Specific volume, cu ft per lb, v
Pipe diameter, inches, D
Flow, lb per hr, F
Length, ft, L
Pressure drop, lb per sq in., ΔP
Note: for other flows, divide actual flow F by 10, multiply ΔP by 100
Chart is designed so that as final operation, straight edge is held on t axis and rotated. Thus a pipe diameter D may be selected commensurate with reasonable pressure drop ΔP

Fig. 3—Nomogram solves for related pipe diameter and fluid pressure loss with given values of friction factor, fluid specific volume and hourly flow. Example: Lay straight edge from 0.0040 friction factor to 1.00 lb per cu ft specific volume and locate point of intersection with q axis. Lay straight edge from this point to 125,000-lb-per-hr flow to locate intersection point on s axis. From this point lay straight edge to 95-ft length to intersect with t axis. About t axis intersection revolve straightedge to determine related values of inches pipe diameter and pressure drop

# Simplified Short-Circuit Analysis For Small Electrical Systems

***A plant engineer can figure circuit-breaker size for new feeders or existing-branch expansions. Assistant Editor John L King tells how to determine short-circuit current in a small industrial generating and distribution system***



**A plant engineer can determine the circuit-breaker size and interrupting capacity for improvement and expansion in his electrical system. Adequate protection for the branch circuits in an industrial plant is provided by the panel shown above**

▶ SHORT-CIRCUIT STUDIES are too often thought of as complicated problems involving higher mathematics that requires laborious analysis on a special calculating board. True, short-circuit studies can become quite involved and the calculating board has a definite place in system analysis. But close approximations can be made for short-circuit conditions that do not involve more than simple mathematics. Application of these approximation methods is well within the accuracy required in the average industrial-plant distribution system. The plant engineer who wants to improve or enlarge his electrical-distribution system and provide adequate protection will find this simplified analysis of short-circuit conditions easy to understand and apply.

When a fault occurs on an ac circuit the short-circuit current is determined by Ohm's Law from the voltage of the effective source and the impedance of the circuit between this source and the fault. Short-circuit current equals voltage divided by the impedance between the voltage source and the fault. Unless an infinite or unlimited generating system is assumed the generating capacity of the effective source must also be given proper consideration.

Line-to-neutral operating voltage at the point of fault is used as the voltage of the effective source on 3-phase systems. Full-voltage value is used because the current to be considered flows before the voltage can be effectively reduced.

Impedance of an ac circuit consists of two components, one resistance and the other reactance. These two components are at right angles; therefore they must be added vectorially. Inductive reactance, used in short-circuit calculations, is very large compared to the resistance. When reactance and resistance are added vectorially the resultant impedance is only slightly larger than the original reactance. In Fig. 1, $R = 0.04$ ohms and $X = 0.12$ ohms; therefore:

$$Z = \sqrt{R^2 + X^2} = \sqrt{(0.04)^2 + (0.12)^2} = 0.1215 \text{ ohms}$$

which shows only a slight increase over the original value of $X$. In simplified calculations the effect of resistance is omitted, and reactance used in place of impedance. The error thus introduced is on the safe side for circuit-breaker selection because calculated values of current flow are slightly larger than actual values.

Synchronous generators are usually considered the only generating equipment connected to a power system. Motors and other rotating machines that draw power from the system are normally energy-consuming devices. On short circuits, however, these rotating machines run by inertia and turn into generators. Energy then flows from them into the

fault. Therefore total current flowing to the fault from the effective source is that supplied by the normal generating equipment, plus the current from all motors. In determining the total primary kva capacity that can feed a fault in a limited system the summation of the reactances from the various sources to the fault is used. In analyzing the primary system large synchronous motors can be considered generators. Treatment of groups of induction and synchronous motors in load centers will be discussed in detail in the second of this series and therefore is omitted here.

Short circuits occur in four different ways on a 3-phase system:

1. Three-phase faults are the most severe but occur less often than other types. These shorts are a solid tie between all three conductors.

2. Two lines to ground on grounded neutral systems are almost as severe as 3-phase faults and occur quite frequently. These shorts are a solid connection between two conductors and the ground.

3. Line-to-line faults are a solid connection between two lines. They are much less severe than two lines to ground faults and do not occur so often.

4. Single-phase-to-ground faults on a grounded neutral system are the least severe of all but occur more often than any of the others. They represent one line connected solidly to ground.

Three-phase faults can be easily reduced to a single-phase or one-line representation because they affect all three phases simultaneously. Simplified calculations are made for 3-phase faults because they represent the severest conditions. Equipment that protects these faults is always more than adequate for all others.

Current that flows in this kind of fault is equal to line-to-neutral voltage divided by the reactance of one phase, or is equal to the line voltage divided by the reactance times the square root of three.

(*A*) Short-circuit current =

$$\frac{\text{line voltage}}{\text{reactance (ohms)} \times \sqrt{3}}$$

On the 3-phase generating system of Fig. 2 assume a fault at *N*. Reducing this to a single-phase representation, Fig. 3, the short-circuit current is found by (A) above:

Short-circuit current =

$$\frac{2300}{(0.4 + 0.51) \times 1.73} = 1460 \text{ amp}$$

This computation becomes more complicated if a transformer is inserted in the circuit between the generator and fault because two different voltages have to be considered. To add the reactances of generator, transformer and line and use a single voltage it is necessary to convert the ohmic reactances to the voltage used. This is done by multiplying the ohmic reactance by the square of the ratio of transformation in the direction the change is made. Adding the transformer to Fig. 3 it becomes the circuit in Fig. 4.

**Fig. 1—This vector diagram shows phase relation of resistance, reactance and impedance in ac circuits. Impedance is slightly larger than reactance**

Generator and transformer reactance =

$$(0.4 + 0.2) \times \left(\frac{22{,}000}{2300}\right)^2 = 54.8 \text{ ohms,}$$

and short-circuit current =

$$\frac{22{,}000}{(54.8 + 0.51) \times 1.73} = 230 \text{ amp}$$

Such calculations would soon become laborious and intricate if several generating sources and voltages were involved. Therefore two other systems have been devised to make these calculations in simplified form where highly accurate results are not needed. They are the per-unit and percent methods. In the per-unit method reactance in ohms, volts, amperes and kilovolt-amperes are expressed in units of arbitrarily selected values. These values are referred to as 1, or base ohms, volts, amperes or kva. In the percent method these values are referred to as 100%, or base ohms, volts, amperes or kva. Per-unit values are equal to percent values divided by 100, and percent values equal per unit times 100.

Sub-transient reactances are always used for synchronous generators and should be obtained from the manufacturer. Transformer reactances can be taken from name plates because they are part of the standard marking. Cable and distribution-line reactance values have to be calculated or taken from tables in handbooks.

Generator and transformer reactance values are expressed in percent and refer to the kva of the machine as a base. Cable and transmission reactance are usually expressed in ohms and have to be converted to percent values at the system base. See formula (*D*), p 80.

Percent reactance is defined as the

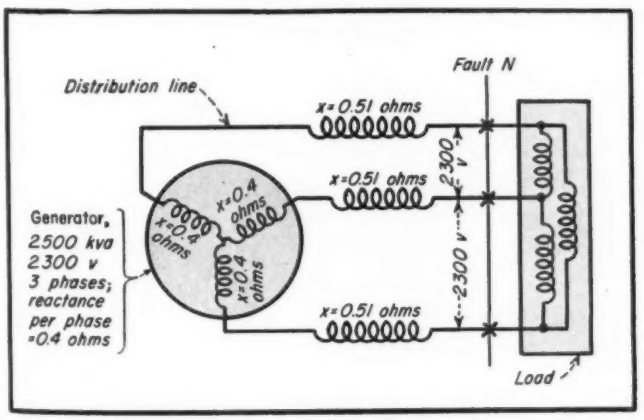



**Fig. 2—Typical 3-phase generating system shows generator and line reactance between energy source and fault point**

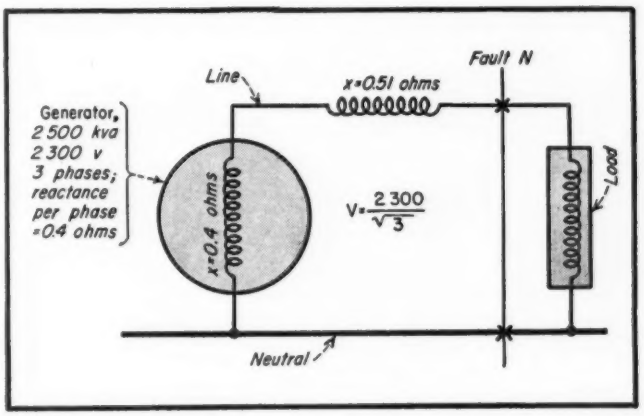



**Fig. 3—Generating system, Fig. 2, reduced to single-phase representation shows line-to-neutral voltage and reactance**

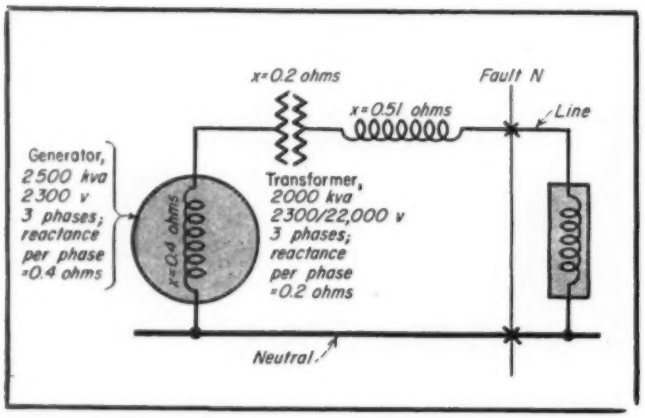



Fig. 4—Transformer is added to single-phase system, Fig. 3, to represent typical operating distribution conditions

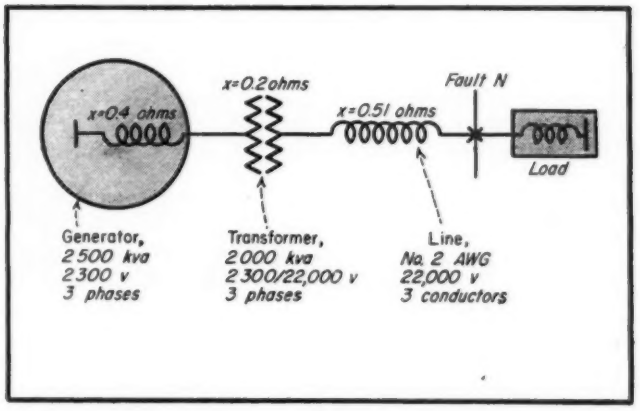



Fig. 5—Single-phase system, Fig. 4, is reduced to one-line diagram. This type of layout is for power-system studies

voltage drop, expressed as a percentage of the rated voltage, when rated current flows. From this statement we write the formula:

(*B*) Percent reactance ($\%X$) =

$$\frac{\text{reactance (ohms)} \times \text{amp (line-to-neutral)} \times \sqrt{3} \times 100}{\text{voltage (line-to-line)}}$$

or

$$\%X = \frac{X_o I_n \sqrt{3} \times 100}{E_l}$$

Kva is easier to use as a base than the current therefore we determine the current in terms of kva and substitute it in the reactance formula (*B*) above.

Current or line-to-neutral amperes equals 3-phase kva times 1000 divided by the line-to-line voltage times square root of three.

(*C*) Amp (line-to-neutral) =

$$\frac{\text{3-phase kva} \times 1000}{\text{voltage (line-to-line)} \times \sqrt{3}}$$

or, $I_n = \dfrac{\text{kva} \times 1000}{E_l \sqrt{3}}$

Substituting the current found in (*C*) into the reactance formula (*B*) we get:

(*D*) Percent reactance ($\%X$) =

$$\frac{\text{reactance (ohms)} \times \text{3-phase kva} \times 100{,}000}{\text{voltage}^2 \text{ (line-to-line)}}$$

or, $\%X = \dfrac{X_o \times \text{kva} \times 100{,}000}{E_l^2}$

Formula (*D*) determines the percent reactance of a distribution line or other equipment where the reactance is given or calculated in ohms. It is also useful in transferring reactances from one base to another. See formula (*E*), below.

Calculated reactances can be obtained on any convenient kva base. On any specific system the generators, motors and transformers generally have different kva ratings. Reactances of these machines are always given in terms of a machine's rated kva as base. Therefore in preparing a short-circuit study of the system: (1) select a kva base, and (2) convert all reactances to equivalent values at the base kva. All reactances must be expressed on a common kva base before they are added or combined.

Reactances vary directly with the kva; therefore by simple ratio a reactance can be converted to an equivalent value at another kva.

(*E*) $\%X_2 = \%X_1 \times \dfrac{\text{kva}_2}{\text{kva}_1}$

A reactance of 18% at 16,000 kva would become $18 \times \dfrac{10{,}000}{16{,}000} = 11.2\%$ at 10,000-kva base. It makes no difference what kva base is selected, but 10,000 is recommended because of its convenience in slide-rule computations.

Since the percent system of short-circuit calculations is used where highly accurate results are not needed, reactances are combined directly without taking voltage transformation into account.

Even though voltage transformation is omitted from the calculations a common voltage base is implied. This base for the reactance of any part of the system is equal to the operating voltage at that point.

The single-phase system, Fig. 4, is reduced further to a simple one-line diagram, Fig. 5, and the percent system is applied to determine the short-circuit current.

A system base of 10,000 kva is selected.

Generator $\%X$ at generator base =

$$\frac{0.4 \times 2500 \times 100{,}000}{(2300)^2} = 18.8\%$$

Generator $\%X$ at system base =

$$\frac{18.8 \times 10{,}000}{2500} = 75\%$$

Transformer $\%X$ at transformer base =

$$\frac{0.2 \times 2000 \times 100{,}000}{(2300)^2} = 7.5\%$$

Transformer $\%X$ at system base =

$$\frac{7.5 \times 10{,}000}{2000} = 38\%$$

Transmission line $\%X$ at system base =

$$\frac{0.51 \times 10{,}000 \times 100{,}000}{(22{,}000)^2} = 1\%$$

## TABLE I—PERCENT REACTANCE FOR EACH MACHINE

| *Machine* | *Kva* | *Line voltage* | *Percent reactance at machine base* |
|---|---|---|---|
| Generator A | 1000 | 2300 | 11.2 |
| Generator B | 2500 | 6600 | 9.7 |
| Transformer C | 3750 | 6600/2300 | 6.2 |
| Transformer H | 1500 | 2300/440 | 5.1 |
| Transformer J | 3750 | 2300/440 | 5.6 |
| Synchronous motor P | 500 | 440 | 22.0 |

Cable E: 2500 v, 465 ft long, 3 conductors, lead covered, 300,000 cm, varnished-cambric insulation, reactance = 0.013 ohms

Cable F: 2500 v, 530 ft long, 3 conductors, lead covered, 500,000 cm, varnished-cambric insulation, reactance = 0.012 ohms

## Table II—Percent Reactance at System Base

| *Machine* | *Percent reactance at system base* |
|---|---|
| Generator A | 112.0 |
| Generator B | 38.8 |
| Transformer C | 16.5 |
| Transformer H | 34.0 |
| Transformer J | 14.9 |
| Synchronous motor P | 440.0 |
| Cable E | 2.4 |
| Cable F | 2.3 |

Total % $X$ from generator to fault at system base = 75 + 38 + 1 = 114%.

The kva that can feed a fault equals base kva divided by percent reactance over 100.

$$(F)\ \text{Fault kva} = \frac{\text{kva (base)}}{\frac{\%X}{100}}$$

Fault kva at $N$, Fig. 5, =

$$\frac{10{,}000}{\frac{114}{100}} = \frac{10{,}000}{1.14} = 8780 \text{ kva}$$

Dividing the %$X$ by the factor 100 reduces it to unit values, so the answers will be in kva instead of percent kva.

The fault current corresponding to the fault kva equals the fault kva times 1000 divided by line-to-line voltage times square root of three.

$$(G)\ \text{Fault current} = \frac{\text{kva (fault)} \times 1000}{\text{voltage (line-to-line)}\ \sqrt{3}}$$

Fault current at $N$, Fig. 5 =

$$\frac{8780 \times 1000}{22{,}000 \times \sqrt{3}} = 231 \text{ amp}$$

Note that this value is slightly higher but essentially the same as that calculated for the circuit in Fig. 4, by the long method, which was 230 amp.

The steps in ($F$) and ($G$) can be expressed as a single statement. Fault current equals the base kva times 100,000 divided by the percent reactance times the line voltage times square root of three.

$$(H)\ \text{Amp (fault)} = \frac{\text{kva (base)} \times 100{,}000}{\%X \times \text{voltage (line-to-line)} \times \sqrt{3}}$$

$$\text{or } I_f = \frac{\text{kva}_b \times 100{,}000}{\%X \times E_l \times \sqrt{3}}$$

Most power systems are more complex than the simple layout in Fig. 5. Therefore an example is given to show all steps necessary to determine the short-circuit kva and current at the point of fault in a system containing equipment shown in the one-line diagram of Fig. 6. Constants of the machines, as given on the nameplates or supplied by the manufacturer are listed in Table I. Point of fault is assumed to be at $W$ as shown on circuit-feeding transformer $H$, Fig. 6. A system base of 10,000 kva is selected. First step is to change all machine percent reactances in Table I to 10,000-kva base.

For generator $A$ the new reactance becomes:

$$\%X = \frac{11.2 \times 10{,}000}{1000} = 112\%$$

Using the same method for determining the other reactances at the common base they become as listed in Table II.

After the reactances have been referred to a common base, they are reduced to an equivalent value for the entire system at the point of fault. To accomplish this, series reactances are added directly and parallel reactances are combined by taking the reciprocal of the sum of the reciprocals. Parallel reactances in groups of two are combined by dividing the product by the sum.

Starting with the most remote points the reactances to the fault point are summed up and combined into an equivalent value. Generator $B$ and transformer $C$ in series become 38.8 + 16.5 = 55.3%. Reducing generator $A$ and generator $B$ plus transformer $C$ reactances in parallel to equivalent value at bus $D$ they become:

$$\frac{112 \times 55.3}{112 + 55.3} = 37.2\%$$

The two cables in parallel become:

$$\frac{2.4 \times 2.3}{2.4 + 2.3} = 1.2\%$$

The generator and transformer equivalent at bus $D$, plus the parallel cable in series, gives 37.2 + 1.2 = 38.4% as equivalent for this branch to bus $G$.

Synchronous motor $P$ and transformer $J$ in series become 440.0 + 14.9 = 454.9% at bus $G$. Two circuits that are in parallel at bus $G$ are as follows:

$$\frac{38.4 \times 454.9}{38.4 + 454.9} = 35.5\%$$

This is the system equivalent reactance at bus $G$, which is the same as the point of fault.

The fault kva at $W$ is:

$$\frac{10{,}000}{\frac{35.5}{100}} = 28{,}300 \text{ kva—See } (F) \text{ above.}$$

and the fault current is:

$$\frac{28{,}300 \times 1000}{2300\ \sqrt{3}} = 7070 \text{ amp—See } (G) \text{ above.}$$

This is the current which feeds the fault on branch circuit from bus $G$ and which would have to be interrupted by a circuit breaker.

Method to determine the system reactance and fault current at $W$ in this example can be applied to any system. The procedure is no more complicated than the example but may be longer or shorter depending on size of system.

No effort has been made here to show how to apply the results of the system short-circuit calculations to circuit-breaker selection. In the second of this series, selection of circuit breakers will be discussed by William Deans, chief engineer, I-T-E Circuit Breaker Co.

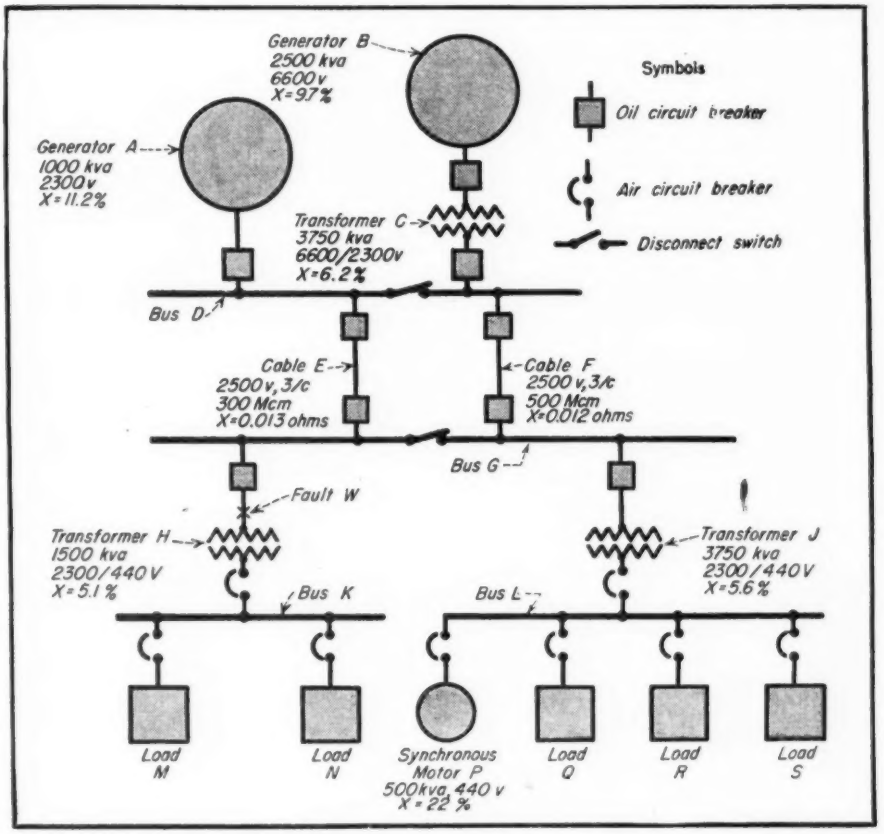



Fig. 6—One-line diagram of distribution system used in the example for finding fault current at W on the branch circuit feeding load center M and N from bus G

# Check Fuel-Injection Equipment To Insure Peak Diesel Efficiency

***Fuel pumps seldom need attention but when they do get out of adjustment, proper corrections must be made. Here are simple rules of timing and calibrating to regain original precision***

▶ BECAUSE OF ITS SOUND DESIGN and precision construction, fuel-injection equipment of modern diesel engines requires little attention. However, occasions do arise when it is necessary for an operator to know how to time and calibrate. The methods covered here apply specifically to jerk-pump systems with plunger-helix control, but the general principles, individually interpreted, can be applied to other types.

Fig. 1 shows the two general types of pumps in this classification: (1) the multiplunger pump, with internal camshaft and one fuel rack for all plungers, and (2) the individual pump, equipped with its own fuel rack and designed for drive from a camshaft supplied by the engine builder. As far as timing and calibration go, the differences between these types are not of great importance, but it is essential to know which is under discussion at any given time. Methods for both are described together, with the differences brought out as each operation procedure through which these types go is discussed. Mechanical-construction details vary: if your pump uses shims instead of screw tappets, has one port instead of two, or has internally bored passages, follow the same principles and make adjustments to allow for mechanical differences as their effects appear.

Timing and calibration, mentioned above, are two separate procedures. Timing refers to the setting of individual plungers with respect to their barrels and to the engine cylinder which they supply, to *start* (or end) fuel delivery at the same time in each cylinder during each cycle, regardless of injection quantity. Pumps with a fixed endpoint for injection are marked in two ways: (1) Those labeled "Timed for Port Closure" have a square top on the plunger with the helix below, Fig. 1. (2) Others marked "Timed for

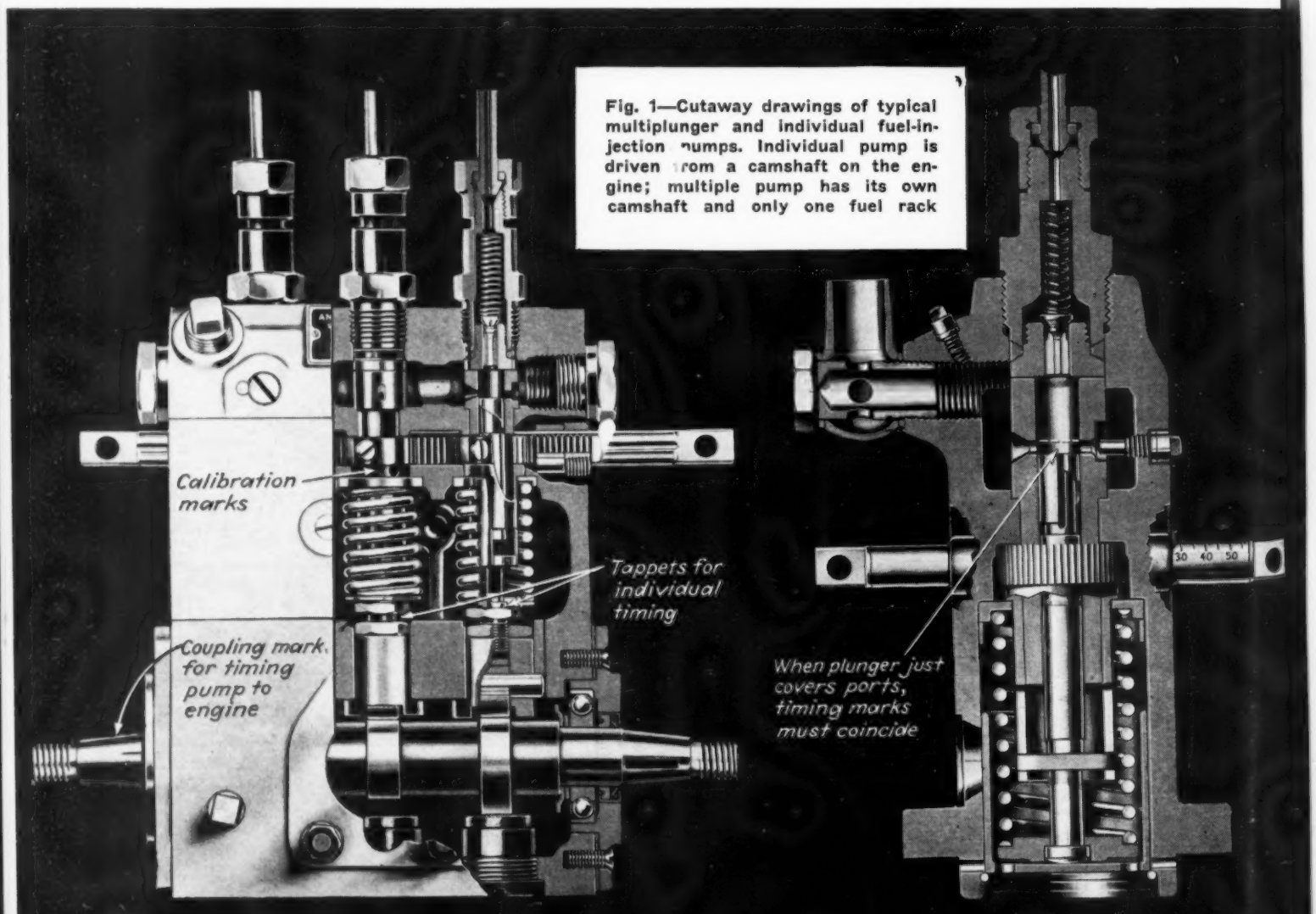

Calibration marks
Tappets for individual timing
Coupling mark for timing pump to engine
When plunger just covers ports, timing marks must coincide
30 40 50

**Fig. 1—Cutaway drawings of typical multiplunger and individual fuel-injection pumps. Individual pump is driven from a camshaft on the engine; multiple pump has its own camshaft and only one fuel rack**

Port Opening" have a helix at the top of the plunger and not at the bottom. With flat-topped plungers, injection begins at the same time from idle to full load. With upper-helix plungers, the start of injection advances with increasing load, but the end of injection remains constant. A third pump type has two helices, which means that start *and* end of injection vary from idle to full load. The first two pump types can be timed without reference to rack setting but the third requires a sort of mutual treatment as there are two interconnected variables.

Engineers apply the term *calibration* to the process of adjusting pumps to deliver identical quantities of fuel to each cylinder irrespective of the moment delivery starts and ends.

### *Timing Marks Preset*

After factory tests, the builder marks a new pump for proper timing and the fuel rack is set to enable the engine builder to install it quickly and accurately without reference to internal measurements. If a pump is known to be in good condition or if a completely new unit is to be installed, procedure is simple. If the pump is an inclosed-camshaft type, bolt it on the engine. Look for radial marks on pump housing and camshaft at the coupling end. Lining these up puts the near-end plunger at position of port closure. Bar over the engine crankshaft until flywheel marks indicate that the corresponding engine cylinder is at the proper position for injections to start. Manufacturer's instructions define this point. Pump may now be coupled to engine.

If a single-plunger pump is to be installed, and the engine crankshaft is correctly fitted, bar over the engine until the cylinder in question is at the position for start of injection. Now adjust the tappets until the mark on the plunger guide cup corresponds to the marks on the pump housing. Fig. 1 (right) shows the guide cup and housing in section; Fig. 2 shows how the coincident marks appear from the outside.

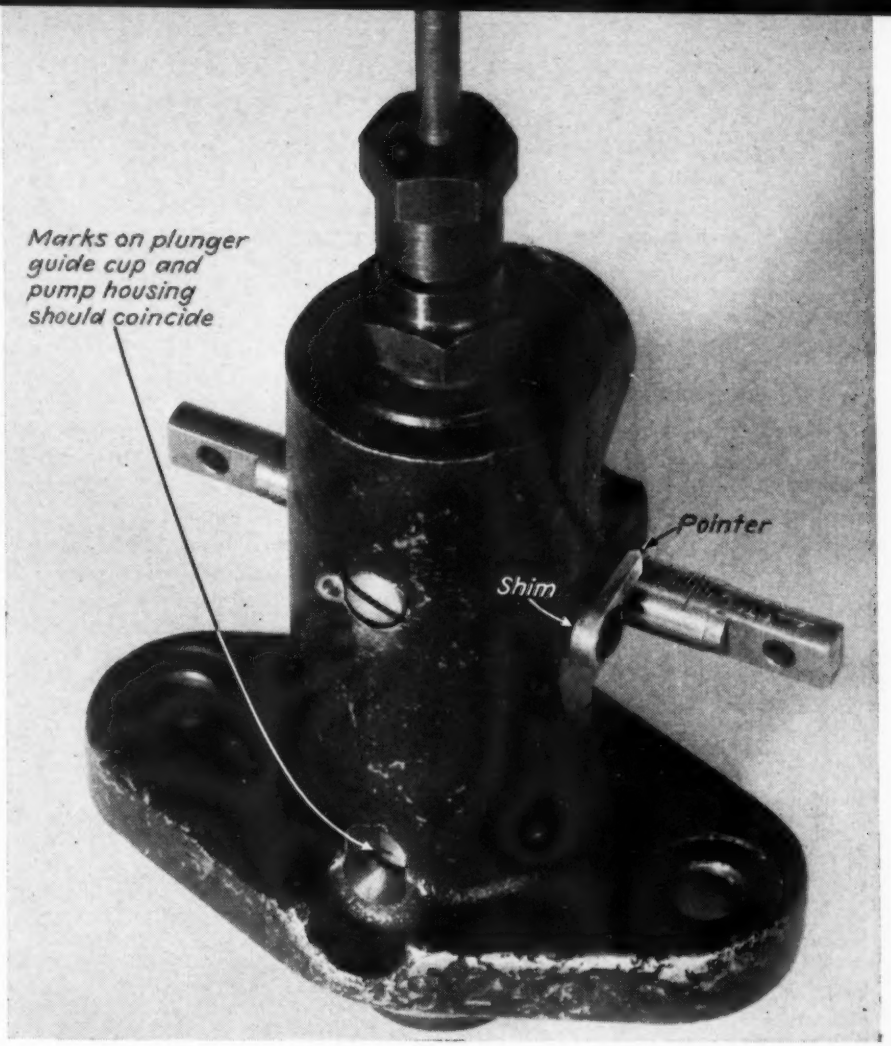



**Fig. 2—Photo of typical individual fuel-injection pump shows, near bottom, the marks on the housing and on the plunger guide cup, which coincide when the pump is timed correctly. Note graduations on the fuel rack and the provision for adjusting the pointer after calibration by inserting shims under the securing screw**

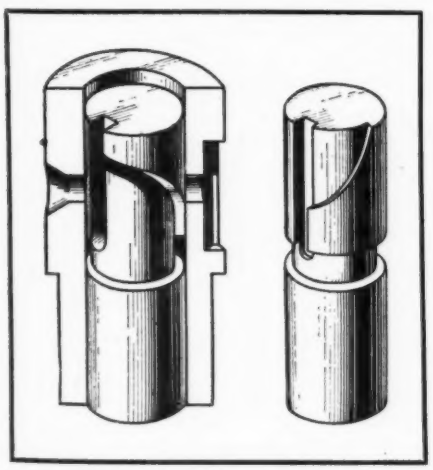


**Fig. 3—Left: This view shows a timed-for-port-closure plunger within its barrel. Right: This plunger is a timed-for-port-opening one not in its barrel**

For an inclosed-camshaft pump, it may be necessary to adjust the tappets individually. Lack of marks on the inside of internal-drive pumps means resorting to other methods: (1) Measure with a depth gage the distance from top of barrel (same as bottom of delivery valve) to the plunger at port closure and, with this dimension known, check it with the pump in place. If, for example, a new plunger and barrel assembly is to be installed, take this measurement before the unit goes into the pump; then, with delivery valve removed, adjust tappets until the indicator shows the same reading. This is called the dry method. (2) To adjust tappets by the wet method, remove the delivery valve and allow fuel to flow, by gravity, through the inlet port and out the top; then raise the plunger until flow just ceases.

Emergency situations may require temporary use of an old pump or parts; this can be done easily with a little analysis of the factors involved. Assume that an inclosed-drive pump is correctly set, but the marks are obliterated, or you want to check them. With delivery valve removed, use one of the above methods to bring pump to port closure on the end plunger. Check marks or make new ones.

### *Replacing Pump Camshaft*

To replace an injection-pump camshaft, which is not part of the pump, you should know something about the cam profile. Without this information, you must find the answer by cut and try. Knowing the full stroke of the pump plunger or, better yet, distance from port closure to top of barrel, you place the camshaft in the engine with the cam all the way up (plunger at top of its stroke) and with the engine barred to a point slightly after end of injection at full load. Now bar over engine to point of injection and adjust tappets to port closure. Finally, bar en-

gine until plunger comes again to the top of its stroke and make sure that it is about 0.020 in. from top of barrel. If you are a tooth off, this measurement will be far out of line; this indicates clearly if the camshaft is not correctly placed. Now that all pumps are accurately timed, calibration can be undertaken.

### *Calibrating Injection Pumps*

Remember that calibration is defined as adjusting pumps to deliver identical quantities of fuel. The amount delivered on each stroke depends on the position of the fuel rack, which turns the plunger. The racks on most pumps are graduated from "stop" to "full load." The inclosed-drive pump has but one rack for all plungers; each individual pump has, of course, its own rack.

Normally, an individual pump needs no provision for adjustment between rack and plunger, and all corrections can be made in the linkage between the individual fuel racks and the main control shaft from the governor. However, an adjustment is provided on some types, Fig. 4. In this unit, the rack engages a toothed quadrant whose position on the plunger can be shifted by means of an adjusting screw. Quadrant adjustments of this kind are customary in multiplunger pumps where the single fuel rack requires some means for changing the relation between individual plungers and the single rack.

Actual calibration may be done in two ways, the easier being as follows: Locate all plungers at about the same vertical position in the barrels by inserting blocks of various thickness between the cams and followers. Cover ports. Set throttle linkage, or the single rack, to its lowest possible idling position. Remove all delivery valves and arrange a gravity head in fuel supply. Rotate plungers, one by one, until fuel begins to flow through, then back off until flow just stops. This is the bypass position where the vertical groove uncovers the port. At this stage the individual pump pointers, Fig. 2, usually read differently. To obtain the same reading of all pointers on the fuel-rack scale, use the pointer adjustment by inserting shims in the required amounts under the pointer-receiving screws.

The harder, but more accurate, method actually measures the discharge from each pump cylinder. This requires simultaneous rotation of the pumps, which is done by motoring the engine or by driving the camshaft separately. Because the quantity of fuel oil discharged during each cycle is extremely small, at least 100 revolutions should be made to secure measurable and accurate results. To test the pump metering (without pressure) disconnect the injection tubing and lead it to separate cups for collecting the fuel. However, actual operation can be simulated by collecting the fuel as it sprays from the nozzles. This is one way of discovering scored or worn plungers.

As mentioned before, double-helix pumps require special treatment when it comes to calibration. Perhaps the best way begins with calibration of all racks to the idling position, as described. Then, with all racks moving together, adjust the pumps to port closure by the flow-through method and then check them for port opening. If this is done carefully, duration of injection in crankshaft or camshaft degrees should be the same on all pumps, and delivery should be equal.

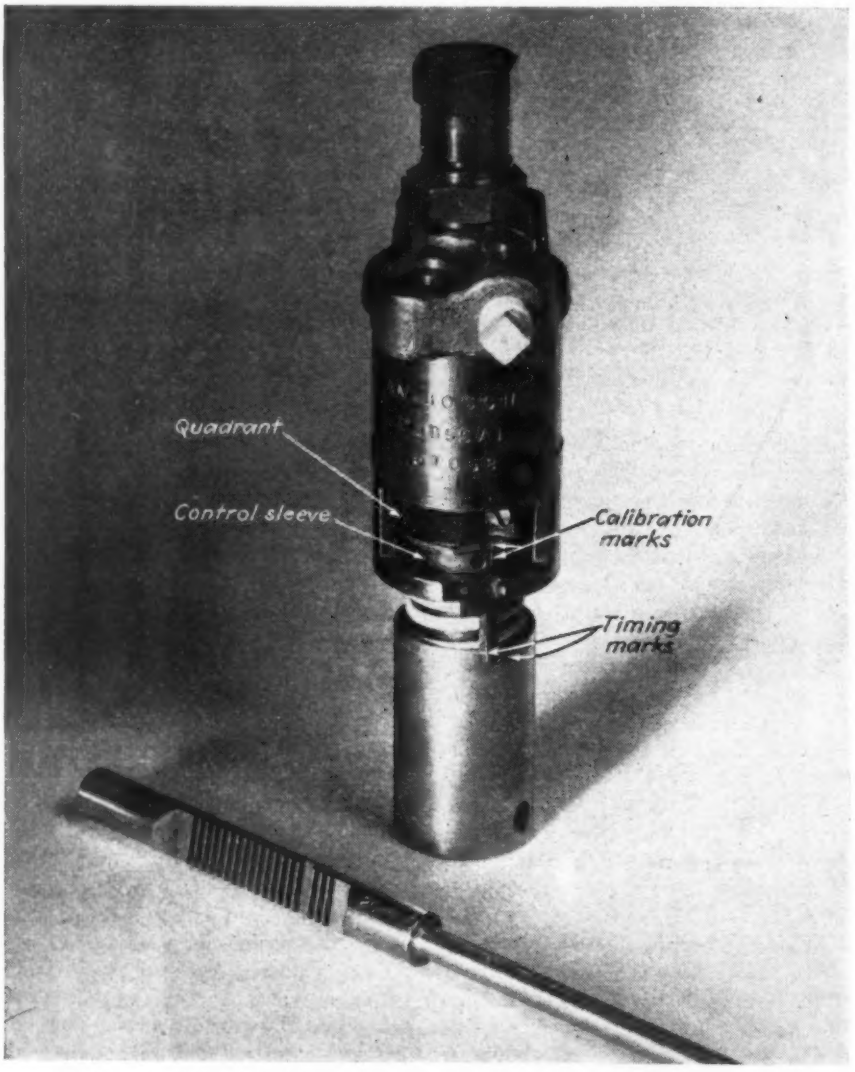



**Fig. 4—This individual fuel-injection pump has a quadrant adjustment. The adjusting screw shown permits turning the quadrant in relation to the plunger and thus provides adjustment between the rack, shown in foreground, and the plunger. Timing mark on projecting finger matches line around the guide cup at port closure**

### *Emergency Changes Timing*

There are times when it may be desirable to undo deliberately all this painstaking work. For an engine operating normally in all respects, injection pumps should be correctly timed and calibrated, but when an abnormal condition develops and it is necessary to continue operation, it may prove advantageous to load cylinders unevenly to compensate for other troubles. Pressure indicators and exhaust-temperature pyrometers give reliable information about the combustion process and, although the injection equipment is known to be perfect, these devices may sometimes reveal substantial differences between cylinders. When this happens, perhaps the safest procedure, if the engine can't be shut down, is deliberately to unload the hot cylinder partially by injection-equipment adjustment. Of course, the engine should be shut down as soon as possible and the necessary corrections made at the seat of the difficulty.

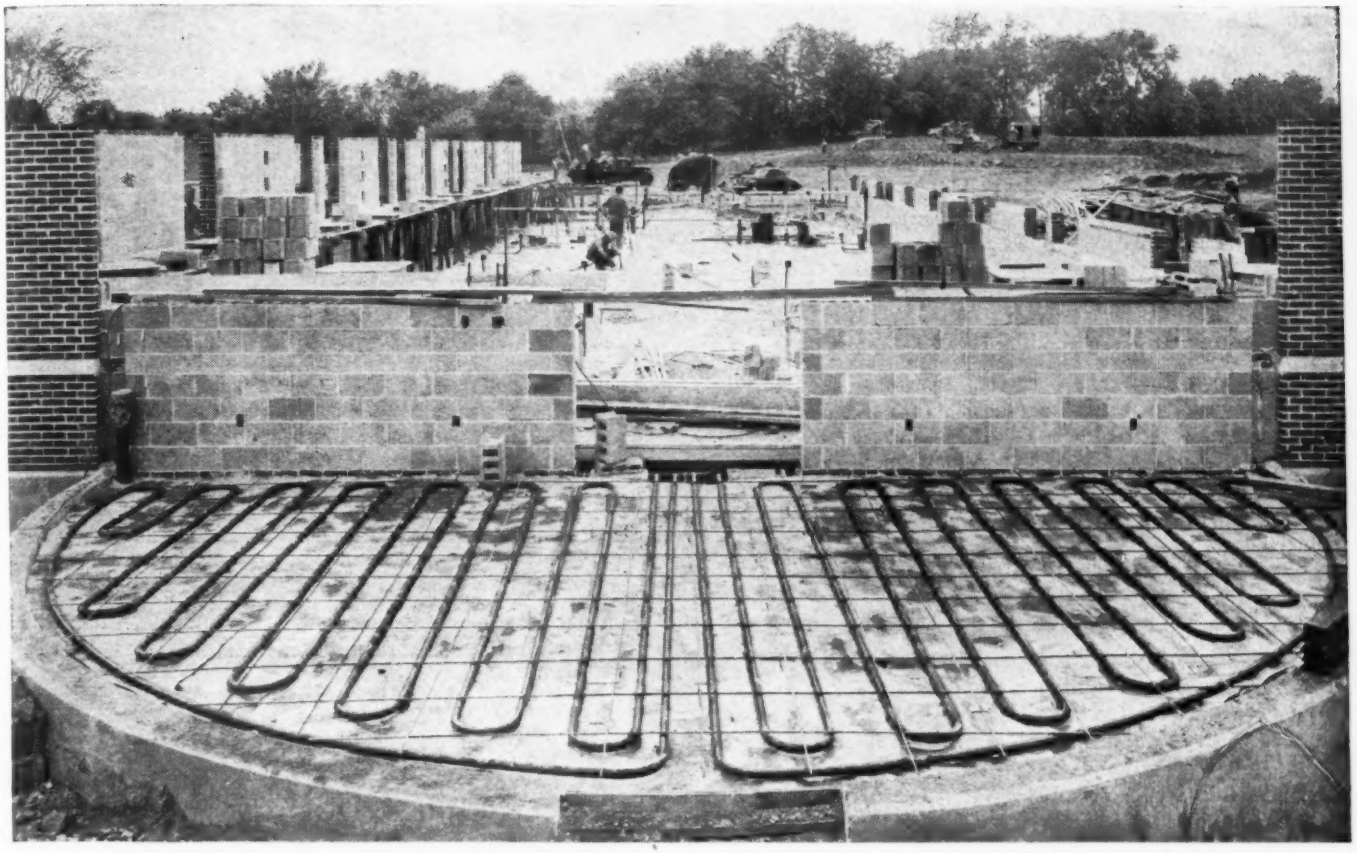


Fig. 1—The solariums posed a difficult heating problem because they are 75% exposed. Two separate coils of 1¼-in. pipe meet the required heat input and feeders run adjacent to the exposed exterior wall where heat loss is the greatest

# Radiant Heating for Modern Construction

***These practical pointers show that installing a radiant-heating system is neither difficult nor excessively expensive if the job is well fabricated and engineered. As with any other heating arrangement this effective system should not be "guessed in"***

By C A HAWK, JR
*A M Byers Company*

▶ A RADIANT-HEATED BUILDING can be comfortable at slightly lower temperature than one heated by a conventional system. The reason is that heat distribution depends not upon air circulation but upon the principle of warming large surfaces so radiation controls loss of normal body heat.

Most radiant-heating systems use hot water. Supplied direct from a boiler or heated by converters on steam lines, it is the most popular medium because of the low cost of converters and circulators. A few installations get good results with steam as the heating medium, but it introduces construction complications and condensate-drainage problems.

Heating large structures like industrial buildings and airplane hangars by a conventional method is usually difficult because high ceilings introduce distribution problems. For instance, in machine shops where small high-temperature heaters are concentrated along exterior walls, employes nearest the elements usually are "baked" while those farther away protest about the cold.

Door openings, such as hoists or airplane hangars need, often cause tremendous heat losses. Reheating an area chilled by opening a large door involves not only considerable time but a great deal of additional heat input. A test in a hangar demonstrated the quick response and economy of radiant heating. The doors were left open until inside temperature dropped 22 deg. After closing them normal temperature was restored in 6½ minutes.

Plants engaged in processes involving considerable water report that floor-imbedded heating coils eliminate damp-floor problems by constant evaporation of moisture. Imbedding the heating pipe in the floor also releases space for machinery, platforms, crane runways and hoists.

Since usual practice imbeds the pipe in concrete walls or floor it must have high corrosion resistance, be easy to bend, either hot or cold, by hand or machine, and to weld, and have a coefficient of expansion about the same as concrete. The latter makes slab cracking negligible. Wrought iron proves suitable in these respects.

When calculating heat load in a radiant-heating floor system for a basementless structure allow 15 to 30% for ground loss. Since the coils conduct heat into the ground as well as into the floor slab, once the system is operating

the ground is warmed and reverse losses diminish. For example, in midwinter the temperature gradient existing between pipes carrying 140-F water and the minimum ground temperature of 50 F, could extend theoretically over a layer of ground 10 ft or more in depth. Heat flow through such a barrier is small. There is no reason to believe that reverse losses with this system are excessive.

Studies show that heat loss is greatest at floor-slab edges and footers. If the slab is poured flush with sidewalls or footers, or both, there is a continuous high-conductance path from the slab to colder areas. Thus, it is advisable to insulate between the slab and sidewalls or footers.

Neither structural nor temperature-distribution reinforcing interferes with radiant-heating coils in concrete slabs, and vice versa. The designer may select the proper reinforcing and then adapt the design accordingly. If there is a possibility of earth settling beneath the slab, practical reinforcing should be installed just as in a normal structural slab.

Slab thickness depends upon floor load. But for efficient heat transmission put the radiant-heating pipes as near the slab top as possible, with a minimum cover of 1.5 to 2 in. If coils are buried deep water temperature must be increased for desired results, although such variations are minor. Most contractors lay coils directly on the fill while others rest them on small concrete piers or the steel reinforcing material.

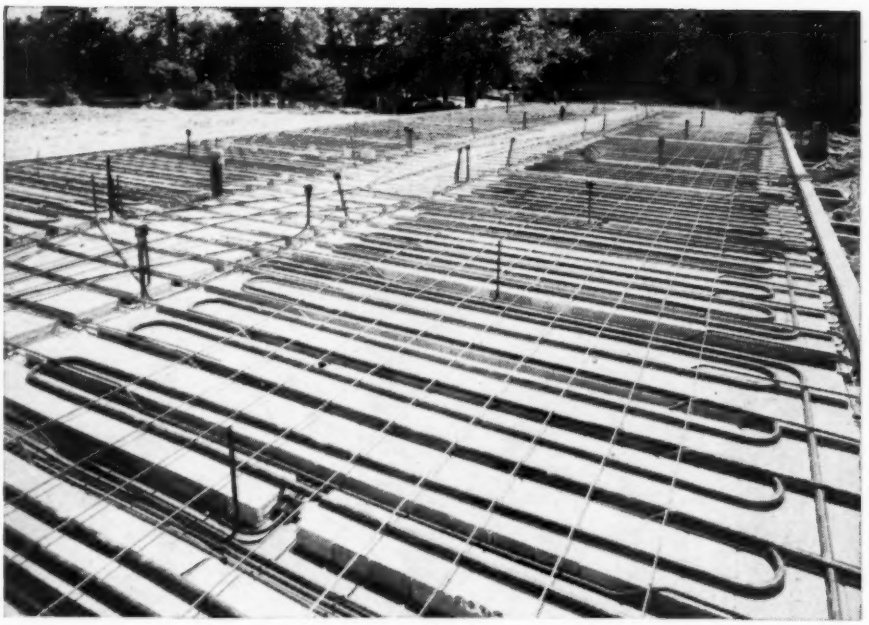


Fig. 2—In one wing prefabricated concrete blocks resting on planks support the pipes and permit laying reinforcing between them. Concrete then covers network

In a large slab, where expansion joints are necessary, there are several ways to install coils so they do not interfere with free slab movement. One practice places them so only bottom of slab contacts them if it is not too thick. When cast in the slab proper, pipe expansion joints or felt sleeves are effective to bridge expansion joints, Fig. 5. Radiant-heating systems operate at relatively low temperature, thus obviating the possibility of heat reducing the concrete's strength.

Heat input to maintain design temperature is the determining factor in coil design, pipe size and spacing. Nearly all the 4000 radiant-heating systems in this country utilize either the continuous coil or grid design. A few installations employ combinations. Coils are designed for their radiating surface and not for hydraulic capacity. The sinuous element may be bent and welded easily as a "custom-built" proposition and transported to the project, or fabricated in the field with simplicity. Also, it can be run into long lengths; 400 ft is not unusual in an industrial installation.

The grid design serves for large floor areas because exceptionally long pipe runs are possible without excessive friction head. Manifolds, or headers, usually are two sizes larger than the grid pipes; therefore tee welding is performed easily.

A simple way to balance a radiant-heating system and avoid short circuiting is to design it on a reverse return or looped circuit. Although separate return lines from individual coils may be run directly back and valved just before entering boiler or heat exchanger, normal practice connects return lines from each element to a common main, and valves each line at the connection.

In a radiant-heating design for any structure, lay out a tentative plan for supply and return mains before considering individual room elements. Determine sizes of mains carefully in accord-

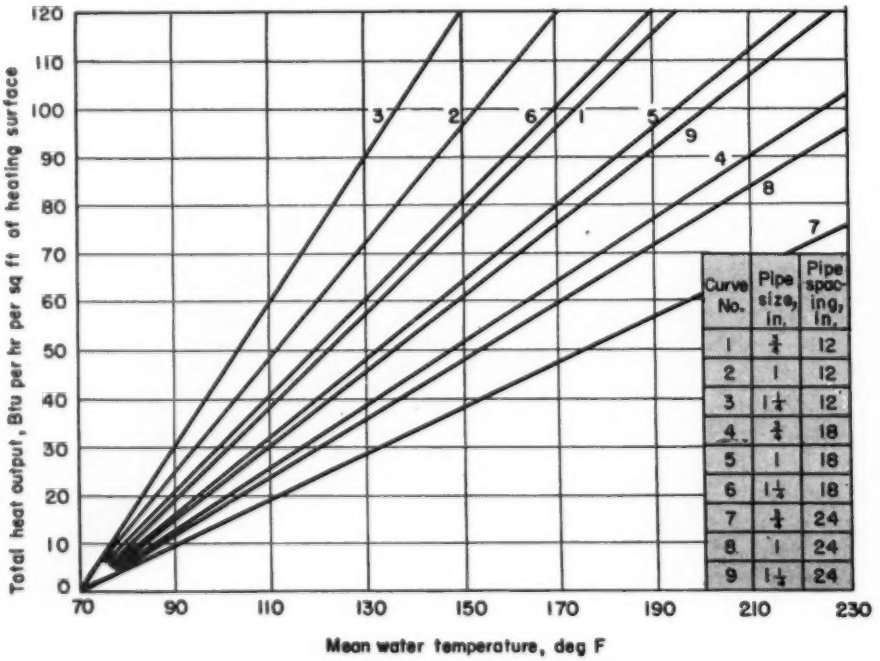



Fig. 3—For radiant-heating jobs the curves show relationship between heat dissipated per sq ft of panel surface, mean water temperature, pipe size and spacing

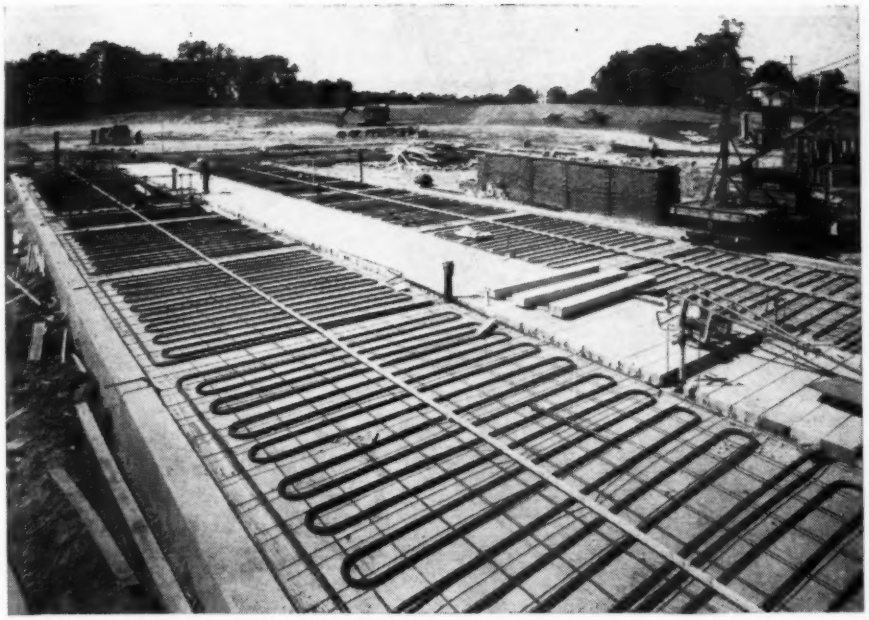


**Fig. 4—Here the sinuous coils rest on waterproof paper laid on a 4-in. gravel fill. Feeder lines run to supply mains in a tunnel now covered with concrete blocks**

ance with hydraulic-flow requirements.

Avoid crossovers if possible because they introduce additional venting and drainage problems. Also, they sometimes make it necessary to increase floor-slab thickness. Even though the system operates at low temperatures and velocities, sound engineering calls for vents in the circuits wherever they change elevation and at all high spots. Manual or automatic vents may be tapped into the lines, and outlets installed at convenient points throughout the building.

### *Controlling Flow*

In small grids fabricated of single pipes in a straight run between two manifolds, it is not necessary to equalize water flow because supply and return connections usually come off at diagonally opposite ends, thereby equalizing frictional resistance in all pipes. However, in a large grid where individual pipes may form a continuous coil, balancing cocks are sometimes installed to compensate for differentials in fluid flow or heat demand.

Amount of pipe to produce desired temperature from individual coils or grids embedded in concrete floors is most commonly calculated by the simple formula given below:

$$P = \frac{HL}{3.5 \times A \times dT}$$

$P$ is linear feet of pipe; $HL$, heat load in all directions; $A$, external pipe surface per linear foot; and $dT$, temperature difference, water to air.

External surface per linear foot of wrought-iron pipe is:

| *Pipe size, in.* | *Surface area, sq ft* |
|---|---|
| ½ | 0.22 |
| ¾ | 0.275 |
| 1 | 0.344 |
| 1¼ | 0.435 |
| 1½ | 0.498 |
| 2 | 0.622 |
| 2½ | 0.753 |

Having established (1) heat-input requirements in Btu per hr per sq ft of panel surface to compensate for known losses and (2) mean water temperature to be used, it is possible to select pipe size and spacing for the radiant-heating elements, Fig. 3.

Experience shows that the closer the mean water temperature is to 140 F, the more efficient the system in over-all size. One-inch pipe is generally used where heat load (taking reverse losses into consideration) is 85 Btu per hr per sq ft of panel surface, or less. Loads under 30 Btu indicate smaller pipe, and those of more than 85 call for pipe larger than one inch. Remember that supply branches for room coils are also thermal conductors and should be calculated in heat input.

Fabrication of pipe into coils naturally involves bending and welding. While a few contractors fabricate them in the shop for transportation to a site, recent trend is toward field fabrication. Portable welding equipment and simple bending tools such as *hickies* (for bending conduit) facilitate the latter method. In building coils be sure to: (1) apply bending stress successively to short pipe sections. (2) Advance the bent pipe out of bending zone so it is not subject to further stress. Apply bending force as a slow, steady pressure instead of a sudden impact or jerk that may flatten or fracture the pipe.

Tests indicate that minimum diameter of cold bends of standard wrought-iron pipe is as follows:

| *Pipe size, in.* | *Bend diameter, in.* |
|---|---|
| ½ | 2.8 |
| ¾ | 3.5 |
| 1 | 4.3 |
| 1¼ | 5.5 |
| 1½ | 7.0 |
| 2 | 11.0 |

When pipe is bent, certain portions are stretched and others compressed. This thins portions of the outer wall and thickens parts of the inner wall. Best practice minimizes these actions. Successful bending demands that no portion of the pipe be stretched beyond a reasonably safe limit and the area of stretch be distributed equally over the entire bend rather than concentrated at one or two points. For a given size pipe, percentage of stretch to make a good bend increases as bend diameter is decreased. For a bend of given diameter, percentage of stretch increases as pipe size increases.

When gas welding wrought-iron pipe, it is not necessary to use high-carbon-alloy rods intended only to increase strength of the deposited metal. Generally, rods that meet the specifications of

(*Continued on page* 154)

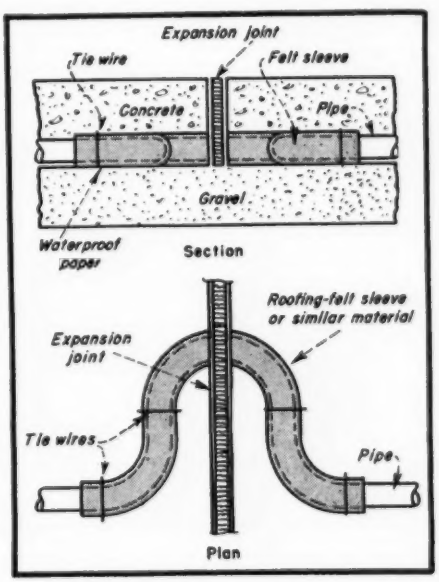



**Fig. 5—Loop the pipe and cover it with felt when crossing the expansion joints**

# Well-Chosen Alarm and Shutdown Instruments Guard Life and Equipment: I

***Even though normal control holds flow, level, temperature, pressure and other variables of a process within specified limits, safety and economy demand additional protective devices to signal when safe operating limits are approached or exceeded***

By C S BEARD
*Instrument Engineer*
*Southern California Gas Co*

▶ AN EMERGENCY INSTRUMENT'S primary purpose is to sound an alarm or shut down equipment upon some abnormal operation. In most instances, the same kind of device built for control service can be used for an emergency trip or alarm, but it is not advisable to use the same unit for both services. Independent connections from the emergency instrument to the system give the added protection of a separate circuit.

Whether an operator or instrument controls the changes that occur in a process, the need for alarms and shutdown devices to protect against the failure of man or machine cannot be denied.

Assume a piston-type gas holder riding on a system between low-pressure blowers and high-pressure compressors. If the electric circuit to the blower motors trips, the high-pressure compressors soon draw the holder pressure dangerously low. Another instance: In a large, 3-electrode, electric furnace, if oil circulation to the transformer stops it is vital that the operator know this immediately. But not relying upon his reactions, the furnace must be shut down automatically.

The same variables that we strive to control with instruments are the ones that may offer a hazard to life or equipment if they exceed a maximum or minimum value. We, therefore, deal with the following functions when selecting equipment that is suitable for alarms:

1. Pressure that is both high and low
2. Level that is high and low
3. Temperature that is high and low
4. Flow rate that is high and low
5. Electrical-circuit characteristics
6. Chemical change
7. Movement

Methods by which an operator is notified of an emergency condition are (1) audible and (2) visible. Experience has shown that in some aggravated cases it might be an excellent idea to employ a type of alarm acting upon the sense of touch. Distinctive-sounding horns or bells serve in locations having only a limited number of alarms, but it is difficult to obtain enough tones to differentiate between a large number. Consequently, best practice is to attract the operator's attention with one horn or bell; he then refers to a panelboard to identify the nature of the trouble.

Central-control panel lends itself to a well-located and engineered signal system because it provides a substantial increase in desirable alarms as new functions are installed. Tendency to add alarms often leads to decentralization and a multiplicity of systems, which cannot but confuse the operators. On the other hand, it is dif-

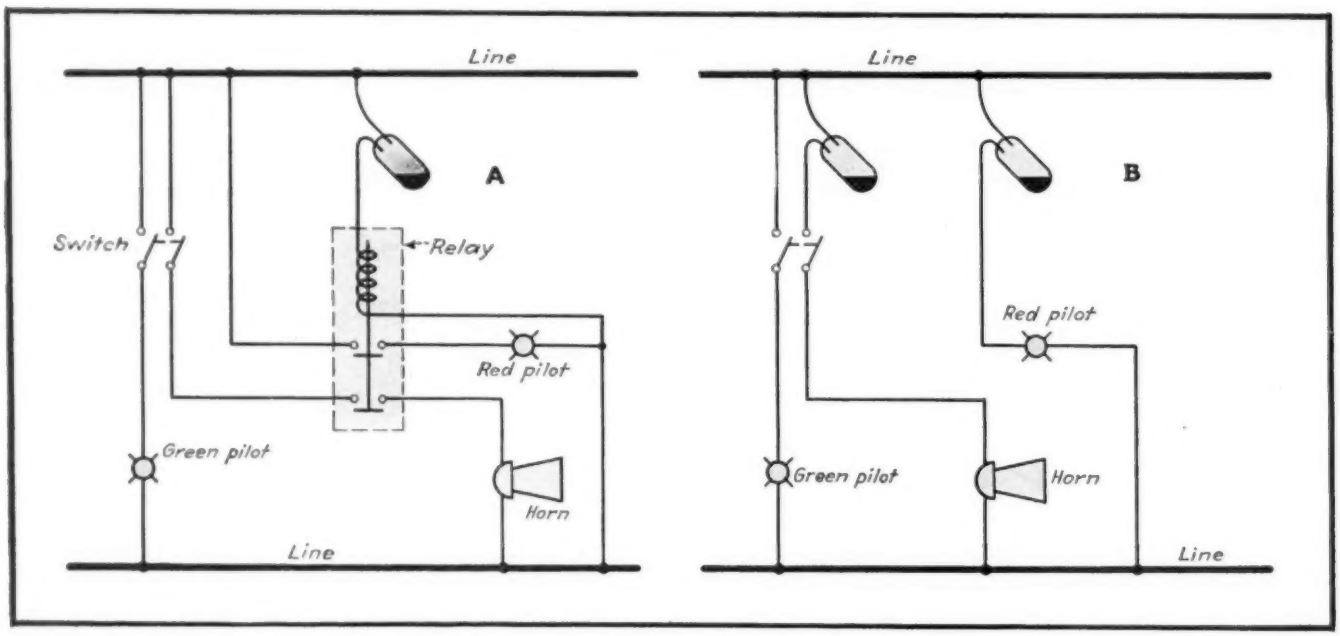



Fig. 1—A switch and relay, or two switches, provide a visible and audible signal to warn of emergency. The same arrangement may shut down a machine. One lamp indicates an energized circuit, and the other the tripping operation

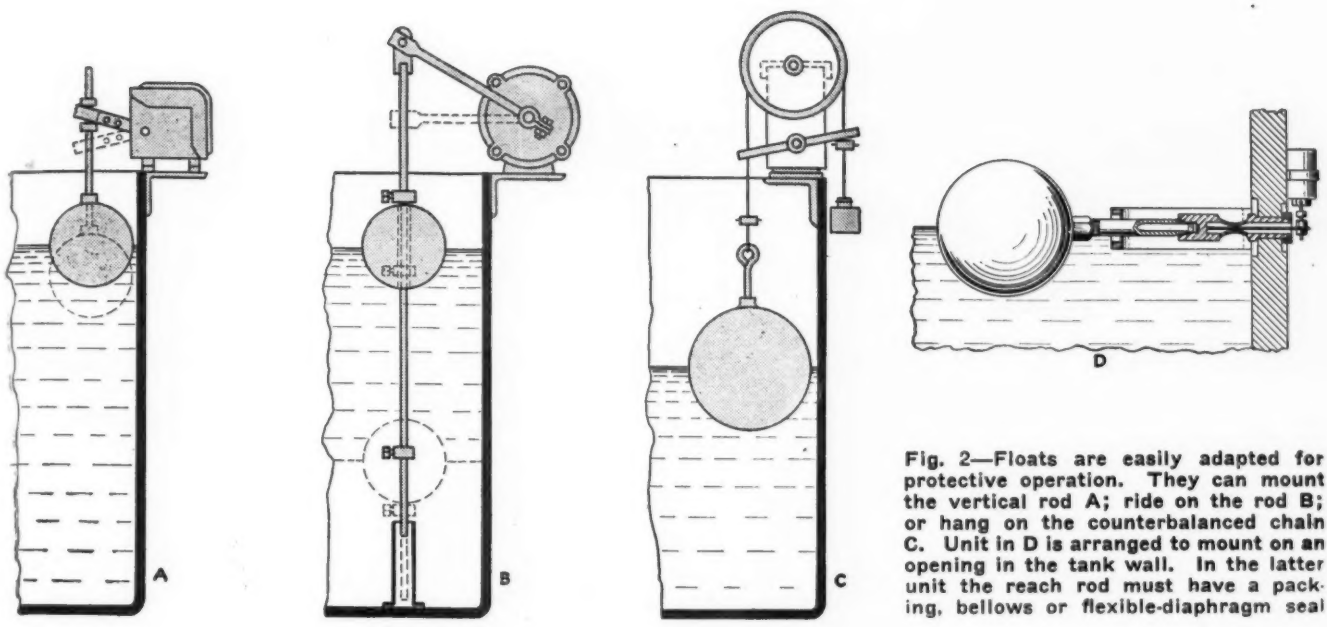



Fig. 2—Floats are easily adapted for protective operation. They can mount the vertical rod A; ride on the rod B; or hang on the counterbalanced chain C. Unit in D is arranged to mount on an opening in the tank wall. In the latter unit the reach rod must have a packing, bellows or flexible-diaphragm seal

ficult to overemphasize the desirability of centralizing identification mediums where the operator can immediately learn what is happening.

If the signal board carries a single lamp for each indication, it is best to have the lamp lighted when the operating function is normal, and extinguished upon emergency. This method precludes the possibility of an emergency occurring without any evidence should a lamp on the alarm board burn out. Using two lamps for each alarm has the advantage of showing when the circuit is energized so that the tripping control device lights a second lamp, Fig. 1, *A* and *B*. In *A*, a mercury switch controls a relay to operate light and horn. When mercury switch is open and alarm circuit energized by closing the supply switch a green lamp burns. Abnormal operating conditions tilt the switch to energize an alarm circuit. Horn may be silenced by opening the supply switch, but a red light shows that relay is still in alarm position. System in *B* is the same except that two mercury switches operate simultaneously instead of the relay.

Instead of lamps, an annunciator board can mount a series of tabs, which drop out to an open position when energized. These identify the instrument concerned in the trouble.

Many valuable emergency devices such as relief valves, explosion disks, and vacuum breakers do not lend themselves to an identifying alarm, but in practically every application an instrument that alarms upon approach to the operating point of the relief can be installed. A study will determine whether it is desirable to give advance notice of this abnormal condition.

Relief of steam from a boiler through the safety valve is usually just an inefficiency, which adequate fuel control corrects. On the other hand, one plant came close to disaster when a large gas holder was evacuated. It ruptured and air was drawn into a system that contained a product readily oxidizable to the point of combustion.

Inasmuch as equipment that can be used for alarm service deals with the maximum and minimum limits of the variable. it is not necessary to incorporate the refinements essential to most controllers for throttling, or resetting, which is so vital to process control. Since installation of shutdown and alarm equipment offers great possibilities for Rube Goldberg inventions, care must be exercised so expectancy of successful operation is not less than that of normal control.

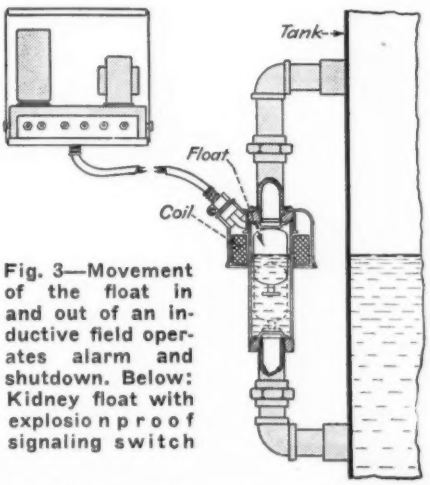
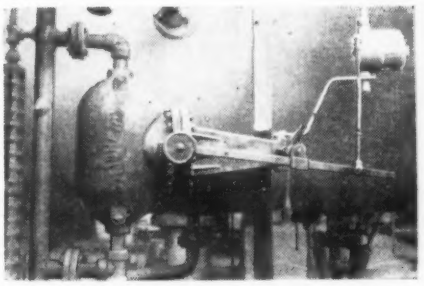



Fig. 3—Movement of the float in and out of an inductive field operates alarm and shutdown. Below: Kidney float with explosion proof signaling switch



For example, consider the protection of an ordinary tank. Selection must be based upon a determination of the circumstances if the tank runs dry, or overflows. An overflow line protects surrounding equipment, but economics demands a notification of this so the condition can be corrected. Low level can be just as critical as high. Practically all methods of determining a variable described in two special sections of POWER ("Measuring and Controlling Liquid Level," April 1945, and "Measuring and Controlling Temperature and Pressure," April 1946) may be adapted for alarms. This article discusses those most readily adaptable for dependable operation.

Floats are the simplest devices for open tanks. They can be attached to the end of a rod as in Fig 2, *A*, ride on a vertical rod, *B*, or hang on a counter-balanced chain, *C*. The switch may be a mercury or knife type. It is neither good practice nor necessary to try to adapt the vertical-rod device to a totally closed tank. Numerous assemblies are available that fasten to the tank side, *D*. Here the float moves within the limits of the bracket because the holding tube is flexible. Switch is actuated by a rod inside the

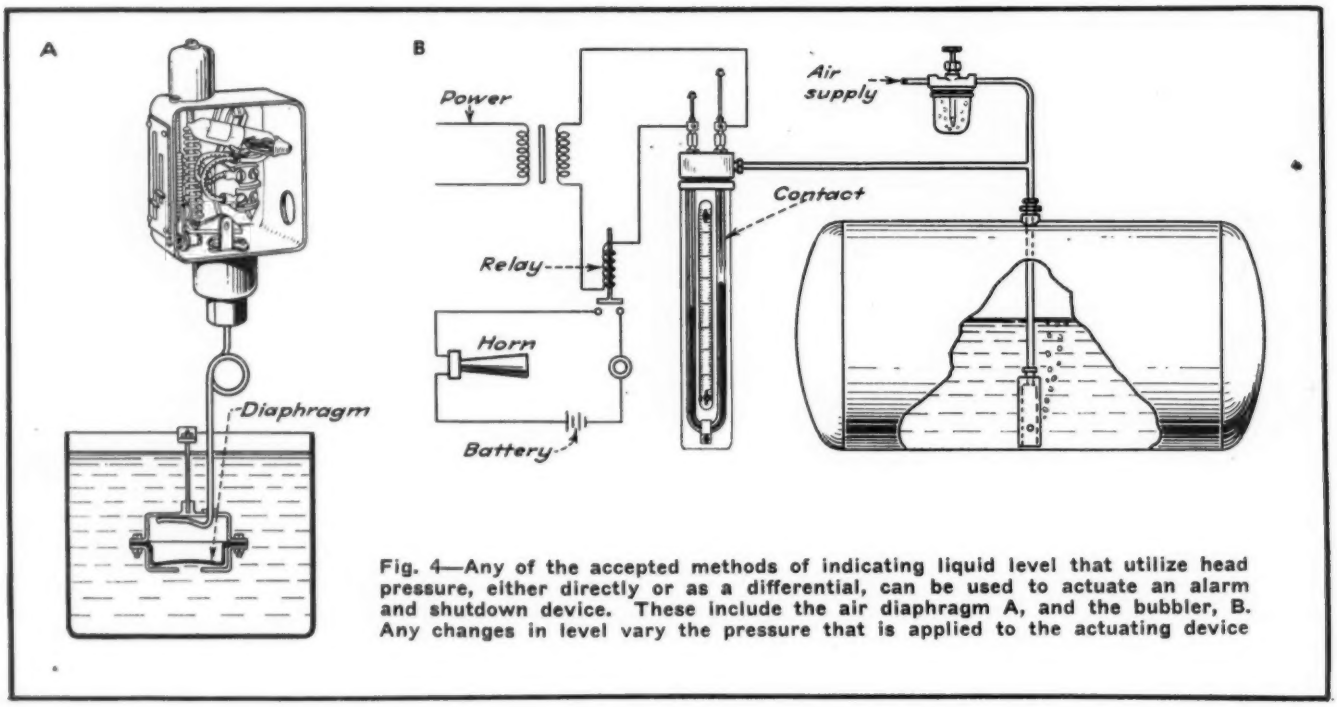


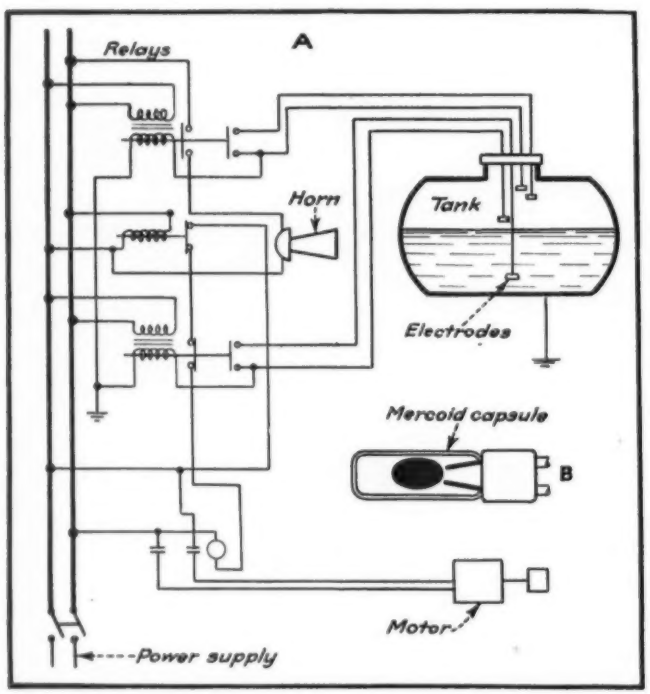

Fig. 4—Any of the accepted methods of indicating liquid level that utilize head pressure, either directly or as a differential, can be used to actuate an alarm and shutdown device. These include the air diaphragm A, and the bubbler, B. Any changes in level vary the pressure that is applied to the actuating device

compressed tube which acts as a seal.

Kidney floats, Fig. 3, offer the advantages of easy removal for inspection, less agitation at the liquid surface, being out of the way of mixers or agitating lines, and of being installed on full tanks. In the inductive float installed as a kidney on a closed tank, movement of the float into the field of the coil operates the alarm system, Fig. 3. Exercise care in selecting a float. Choose one that stands up best in the liquid, is large enough to operate the alarm, and has correctly designed shafting from inside to switch linkage.

Any of the accepted methods of level indication utilizing the liquid head pressure, either directly or as a differential, may actuate an alarm. These include the air diaphram, Fig. 4, *A*, or the bubbler *B*. Changes of level vary the pressure applied to the actuating device.

A differential-pressure instrument compensates for the vapor pressure in a closed vessel because the connection above the liquid transmits the vapor pressure, while the line at the desired depth in the liquid transmits a total pressure equal to the vapor, plus the liquid head pressure. The difference is the liquid-column weight, which may be corrected to linear units for the kind of liquid in the tank. Every differential gage may be used as an alarm, either by using the indicator shaft to actuate a switch or by completing the circuit through contacts in the mercury of a mercury-filled gage. Where hazardous vapors exist, the pneumatic flow controller may operate a remote switch placed outside the danger zone.



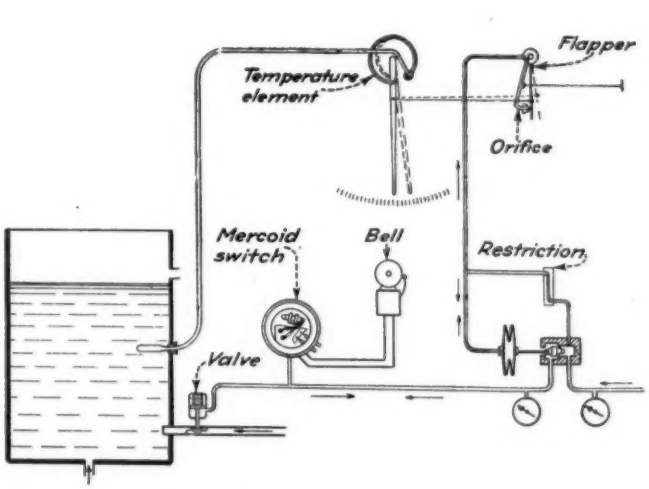




Fig. 5—Above: A pneumatically operated switch sets off an alarm when the valve pressure varies beyond its limits.

Fig. 6—Left: When selecting an instrument that utilizes the conductivity of a liquid to complete a circuit or to short-out a coil, take full advantage of the manufacturer's experience relative to the conductivity of the liquid

Many instruments use the electrical conductivity of a liquid to complete a circuit, or short-out a coil, Fig. 6, *A*. When selecting these instruments take full advantage of the manufacturer's experience relative to the liquid's conductivity. Its chemical characteristics and inflammability determine the circuit and type of electrode.

### *Units Available*

All accepted methods for indicating pressure may be used as an alarm or shutdown. Most widely used device, the bourdon tube, is readily adaptable because the same movement that rotates the pointer can operate either the flapper of a pneumatic controller or a mercury switch. The latter consists of a glass or metal capsule inclosing electrodes in such a position that, upon tilting, a small amount of mercury shifts to make or break the circuit, Fig. 6, *B*. The variety available, ease of mounting, and safe construction make it one of the most widely used devices for controlling low-amperage electrical circuits. When circuit amperage exceeds the switch's rated capacity it energizes a relay to do the heavy job. By proper linkage, rotation of the bourdon-actuated shaft also may be utilized to trip electric contactors.

Movement of a pressure or temperature element may be connected to any of the various pneumatic controllers, Fig. 5. Here a mercury switch is inserted to operate an alarm upon an increase to maximum, or a decrease to minimum, of the valve-diaphragm pressure, which varies with the controller's deviation from the control point. Pressure variation caused by restricting the nozzle may be used in any way desired.

For high pressures the spring- or weight-loaded piston or diaphragm may be used for alarm or shutdown. Serving extensively for low pressures are the inverted-bell instrument, manometer with a float riding on the liquid of one leg, limp-diaphragm gage or bellows. They also serve for differential pressure.

Many instruments that indicate low absolute pressures are difficult to convert into alarms or shutdown devices. Some are the McLeod or Dubrovin gages and micromanometers. When the pressure is low enough to permit using a Pirani or ionization gage, or others that deliver even a small voltage, it is not difficult to use a contactor on the millivoltmeter or potentiometer.

Exercise extreme care in locating the sensitive element of a temperature alarm to be sure the response is a true indication of emergency conditions. An excellent example is insertion of a thermal element to guard against overheating a steam-exchanger, so far away in the discharge line that discontinuance of flow allows the line to cool rather than heat up excessively as liquid in the heater does, Fig. 7. The element must be in the liquid section to be protected. This condition becomes critical in direct-fired equipment.

### *Must React Rapidly*

The same rules that apply to thermal-element installation for controllers, apply to alarms. Make every effort to have the element give rapid reaction, even to the point of eliminating the thermometer well when possible. Means of physically strengthening the element must be used to guard against erosion.

Distention of a bimetallic strip, or helical spring, from temperature changes may operate an alarm.

Temperature is measured by a galvanometer-type pyrometer, potentiometer or resistance thermometer, and it is possible to utilize their movement relative to the temperature that is being indicated for operating the alarm. It may be rotation of the slide-wire contactor, pen-arm shaft, or linear movement of the indicator. Pneumatic temperature controllers, like those for pressure control, are readily adaptable as alarms. The radiation pyrometer may operate high-temperature alarms by applying the signaling device to the indicating or recording instrument.

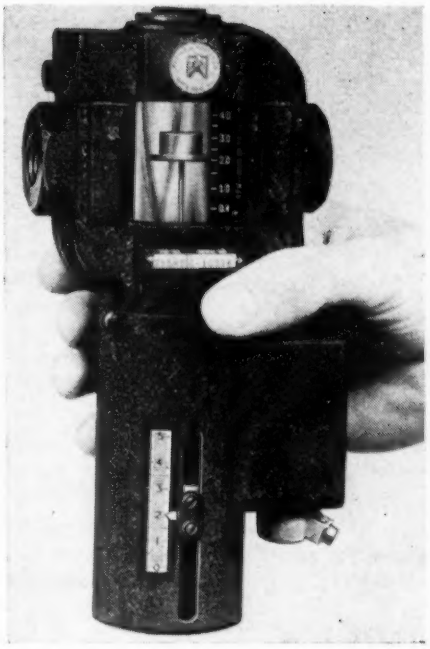


Fig. 8—A flowmeter can operate a contactor magnetically or mechanically

In flow control most frequent need is for an alarm to show that flow has decreased below a desired minimum. Applications include cooling-jacket water for engines, cooling oil in transformers, air flow to soaking or annealing furnaces and air flow for ventilating vaults and shafts. A large percentage of measuring devices, especially recorders or those having indicating pointers, may be adapted for an alarm. The integrating unit, such as a displacement meter, does not adapt itself so readily.

For lines small enough to make a pipe-size fitting economical, the area meter is particularly good, Fig. 8. Float movement can operate a contact electrically, magnetically or mechanically. Here a permanent magnet attached to the float moves within close proximity to and operates a mercury switch or contactors. It is possible to set this instrument quite accurately for very low, or zero flow of fluid or gas.

Movement of a check valve can energize an alarm, either by using a shaft from the clapper to a contactor outside the fitting, or by transmitting clapper movement with a magnet mounted on it to a counterpart outside the fitting.

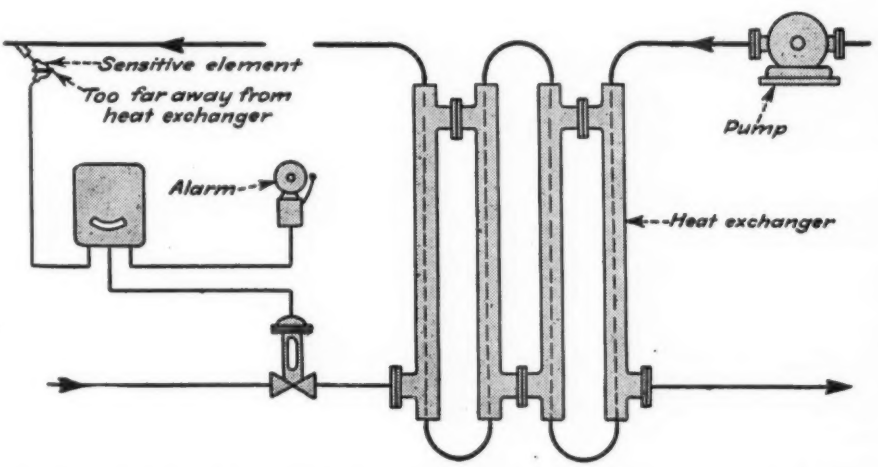



Fig. 7—If a thermal element is to guard a heat exchanger, place it where overheating takes place and not in the line beyond. If discharge stops, line may cool

# SHORT CUTS TO PLANT EFFICIENCY

By W A SHOUDY

## No. 4—How Large a Boiler?

*In this practical series based on fundamentals, experience and common sense, a consulting engineer shows how to design an economical plant for process steam and power. No. 3 of this series appeared in the March issue of* POWER.

▶ NEARLY 20 YEARS AGO I suggested that the expression, *percent of rating*, be eliminated from the steam engineer's vocabulary*, but its use persists and confuses in the selection of boilers.

*Boiler horsepower* was defined at the Philadelphia Centennial in 1876 as the evaporation of 30 lb of water per hour from a feedwater temperature of 100 F to a steam pressure of 70 psi gage. Later, the ASME redefined this term as 34.5 lb per hr "from-and-at 212 F." Since about 10 sq ft (sometimes 12) of heating surface was then required to evaporate the 30 lb per hr, the manufacturer's rating in horsepower became the total heating surface divided by 10.

Until this century most boilers were hand-fired. Grate width was limited by that of the boiler, and length by the distance the fireman could spread coal and clean the grate—usually 7 ft. Enough good coal could be burned to give a safe margin over the rating. Poor coal might not develop full rating.

Mechanical stokers had been used principally to save labor but by the turn of this century it was found that more coal could be burned per square foot of grate by using forced draft and that longer stokers could be built, thus burning 50 to 75% more fuel and thereby developing 150 to 175% of the boiler builder's rating. Soon, with still larger stokers, boilers were operating at 200, 400 and even close to 1000% of rating.

That is all the term, percent of rating, means, but it persists, perhaps because it has been easy to plot draft loss and gas temperatures against it. It is more sensible to plot such values against Btu or evaporation per square foot.

* *Mechanical Engineering*, March 1927, p 212

Soon boiler troubles appeared. Tubes failed because of bad water or poor circulation; water levels were unstable; boilers primed badly and higher pressures made some designs expensive. New designs appeared and disappeared. For very large capacities each boiler was generally tailor-made for local conditions.

### *Watertube Boilers Compared*

The firetube boiler remains with us, substantially unchanged for half a century, but the modern and small-sized watertube boilers have settled roughly into these classifications:

1. The straight tube: sectional or stayed header.
2. The curved tube: (a) 4-drum: 3 steam drums and 1 mud drum (b) 3-drum: 2 steam drums and 1 mud drum (c) 2-drum: 1 steam and 1 mud drum.

Practically all boiler manufacturers are prepared to make any of these types, but some prefer to offer their own modifications. The important consideration to the purchaser is that each type for a given heating surface requires about the same cubic feet of building space. This simplifies the purchaser's problem. He may base his preliminary designs on any of these types and know that he can get competitive prices and similar performance from several manufacturers.

Most expensive of the four is the sectional-header straight-tube type. The box- or stayed-header type is cheaper, but above 250 psi it tends to "weave" and cause tube leaks. Because the box-header boiler is usually cross-baffled, the flue-gas temperatures are generally lower. The low-draft loss makes it suitable for natural-draft installations. The 2-drum type costs no more, sometimes less, and is rapidly replacing the straight-tube type.

The 4-drum boiler tube is 3¼-in. OD. Tubes of 3-in. OD are generally used with the 3-drum type. For 2 drums, 3-in. OD tubes are standard for the first pass and 2-in. OD for the other passes. The

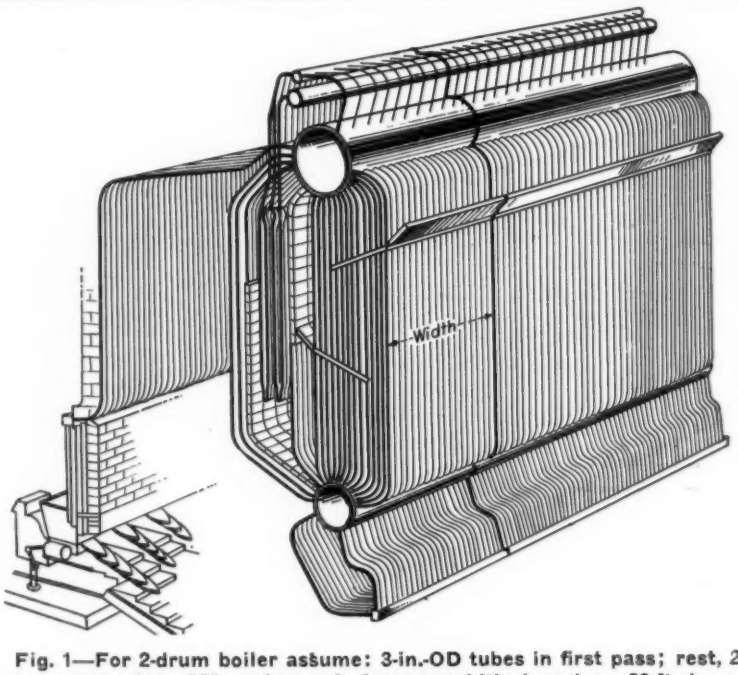



Fig. 1—For 2-drum boiler assume: 3-in.-OD tubes in first pass; rest, 2-in.-OD; heating surface 525 sq ft per ft furnace width, based on 20-ft drum centers

smaller tubes permit closer tube spacing, giving more tubes per foot of furnace width. Result is that for the same vertical drum centers and drum diameter the heating surface of the 4-drum boiler is hardly 5% more than the 3-drum type. Since each delivers the steam from the rear steam drum, out of the main circulators, the quality is the same for either.

The heating surface of the 2-drum boiler is about 5% less than that of the 3-drum type, but because there is only one steam drum all circulation passes through it and leaves less space for steam separation. The maximum capacity with dry steam is therefore lower for the same drum diameter.

For all preliminary purposes the flue-gas temperature may be taken as the same for all three designs of the same drum centers and the same rate of evaporation per sq ft. Baffle arrangement seems to have more effect than number of drums. In some sizes cross-baffling materially reduces flue-gas temperatures.

It is convenient to rate the surface per foot of furnace width remembering that tube centers are 6 to 7 in. That is, the furnace width varies in steps of about 6 in. Number of tubes that can be installed depends on the number that can be placed in the mud drum, whose diameter is usually about 36 in.

The degree of superheat determines the size of the superheater and some boiler tubes may have to be omitted to accommodate the superheater. A study of a series of 2-drum boilers with various sizes of superheaters for several fuels, but all with the same drum-center distance, shows a maximum surface of 557 and a minimum of 510 sq ft per foot of furnace width. The average is 525 sq ft, with not 5% extreme variation, plus or minus. It is much the same for the other types.

### *Boiler Heating Surface*

Also, the heating surface of all curved-tube boilers is almost directly proportional to the vertical drum-center distance. Thus 18-ft centers give 90% of the surface obtained with 20-ft centers. We may estimate the heating surface of any boiler if we know the dimensions of one of the same type.

*Approximate heating surface of curved-tube boilers having 20-ft vertical-drum centers and 36-in. diameter mud drum:*

| *Type* | *Sq ft, per ft width of furnace* |
|---|---|
| 2-drum | 525 |
| 3-drum | 550 |
| 4-drum | 565 |

A further study shows that waterwall surface can be added to average furnace in about the amounts in the table.

The smaller percentages are for operation below full load with occasional short peak loads. The larger percentages are used when the boiler operates for long periods at close to full load. These figures apply to installations up to a capacity of about 150,000 lb per hr.

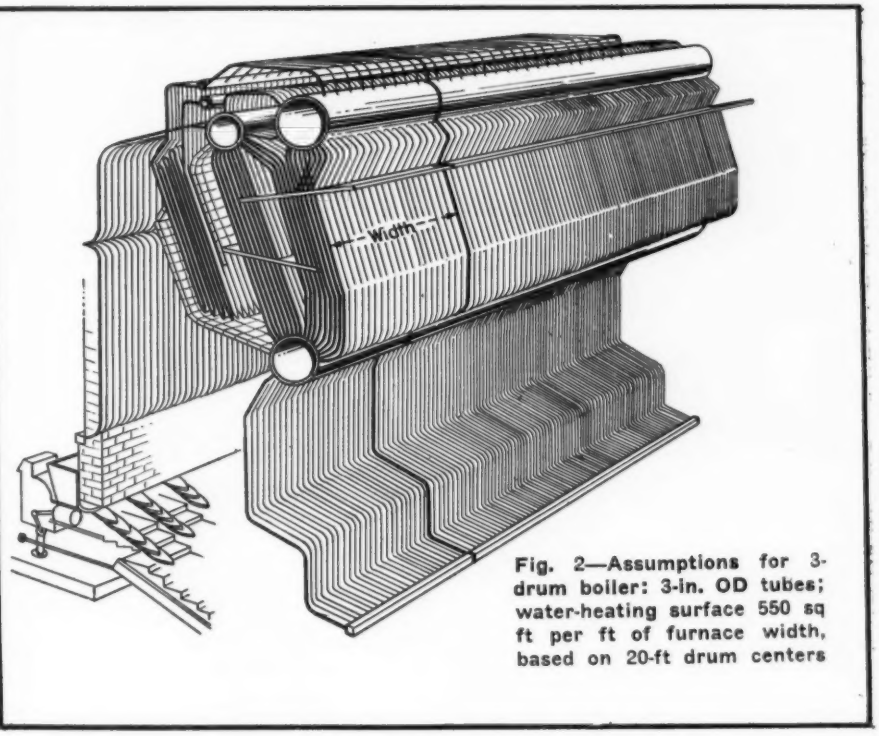



Fig. 2—Assumptions for 3-drum boiler: 3-in. OD tubes; water-heating surface 550 sq ft per ft of furnace width, based on 20-ft drum centers

### *Estimating Boiler Size*

We have now a basis for estimating the size of a boiler for a given furnace. Here's an example:

For a 7-retort underfeed stoker, 12 ft, 3 in. wide: nearest boiler width, 12 ft, 6 in.; 22-ft drum centers; 2-drum 48-in. steam drum:

$$\text{Boiler surface: } 525 \times 12.5 \times \frac{22}{20} = 7200 \text{ sq. ft.}$$

$$\text{Waterwall surface: } 7200 \times 0.10 = 720$$

$$\text{Total surface} = 7920 \text{ sq. ft.}$$

Each manufacturer offers a slightly different surface, but the flue-gas temperatures are the same within the error of measurement. It takes a good man to measure the average flue-gas temperature within 25 deg.

The user may estimate the heating surface of other types in the same way.

With a stoker of the right length this boiler can deliver 75,000 lb of dry steam per hour. This is about 86,000 lb *from and at 212 F*, or 10.9 lb equivalent evaporation, per hour per total square feet of boiler and waterwalls. This is a 316% of rating. If the drum centers were increased to 24 ft the surface would increase and the percent of rating come down proportionally to 289. If centers were reduced to 16 ft, operation would be at 434% of rating for same steam output.

Except for the differences in efficiency, the same weight of coal would be burned in any case and the same weight of steam delivered. The stoker would perform well in all cases. How then shall we select our boiler?

If no economizer or air heater is used we shall probably select the 22-ft drum

## Waterwall Surface Used in Various Furnaces

*Expressed in percent of boiler-heating surface*

| Firing Method | % | Average % |
|---|---|---|
| Pulverized coal and oil | 20–30 | 25 |
| Underfeed stoker | 8–15 | 10 |
| Traveling grate with watercooled rear arch | 20 | 20 |
| Spreader stoker | 10–15 | 12 |

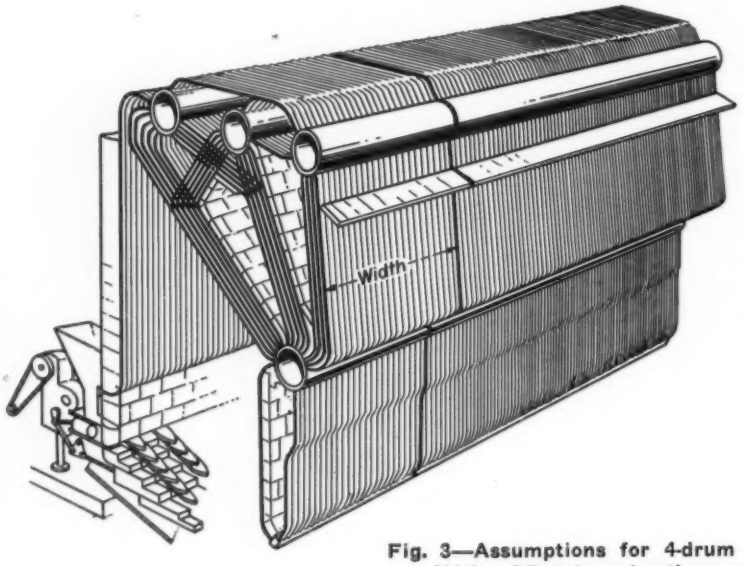



Fig. 3—Assumptions for 4-drum boiler: 3½-in. OD tubes; heating surface of 565 sq ft per ft of furnace width, based on 20-ft drum center distance

centers because the flue-gas temperature for the 16-ft centers is too high, the efficiency too low, while the gain from the 24-ft centers is small and does not warrant the additional cost.

### *Boiler Surface vs Economizer*

We can select an economizer or an air-heater size for each boiler that gives equal final gas temperatures—hence equal overall efficiencies. The low boiler combination with the largest economizer has the highest draft loss, but the need for additional fan power seldom decides the design. Unless the mud drum of low boiler (16-ft center) can be set 10 to 15 ft above the stoker floor the furnace is too low for satisfactory operation at high rates of combustion. We must therefore obtain estimating prices of three sizes of boilers with economizers of such a size that each gives an exit-gas temperature of 350 to 400 F, and compare the difference in first cost of equipment with the difference in annual fuel cost.

### *Limiting Factors*

Let us assume that building restrictions require a narrow boiler and that we must therefore use a 6-retort stoker proportionally longer. The boiler surface is now 6/7 of the surface previously figured, so the percent of rating becomes 7/6, or 369, 327 and 507, all of which are possible. But 75,000 lb of steam must be delivered from a drum whose effective length has been reduced to about 6/7 of 12 ft, 6 in., or 10 ft, 8 in. This reduced drum area so reduces the steam-liberation area that we no longer get dry steam. Some improvement may be obtained by using a larger drum or adding a second steam drum. Limitation on the capacity of any boiler is the amount of dry saturated steam that the steam nozzle can deliver. This limit may be reached at 250% of rating, or 500%. It depends on how many square feet of heating surface empty into the drum.

The maximum quantity of *dry* steam that a steam drum can deliver depends on a number of factors. Feedwater quality has a decided effect. Degree of concentration indicates this quality, but the effect of concentration on moisture in steam is not well understood. Since steam volume decreases with increased pressure for high-pressure boilers, drums generally have a greater capacity than those for low pressure.

The "efficiency" of the dry pipe is another factor. By lowering the normal water level more space is available for larger water-separating baffles and other devices, thus increasing the "efficiency of the dry pipe" and the maximum drum capacity.

Drum capacity is a subject concerning which the purchaser needs the soundest advice. If he is conservative and limits the capacity of a single 48-in. steam drum at 400 psi to 6000 lb per hr per ft of furnace width he will be safe. If a larger capacity is needed, he may use a larger diameter or add another steam drum. Usually the larger diameter is cheaper than the second steam drum. For 250 psi the drum capacity should be reduced to about 4000 lb per hr per ft, but at 600 psi it may be increased to 7000 to 8000 lb per hr. He will be wise to consult several manufacturers.

One other factor must be considered in selecting a boiler. The gas velocity entering the first pass must not be so high that molten ash will be carried into the tube banks and close the gas passes. This is also a furnace problem, which will be discussed in another article.

### *Rules for Boiler Selection*

Quoting again from the same article, which was written when the majority of installations consisted of straight-tube boilers and stokers: "The selection (of a boiler and furnace) must be made in the following manner:

"1. Determine the number of boilers that variations in load and load conditions demand.

"2. Select a grate surface (or furnace) of sufficient size to permit of conservative combustion rates.

"3. Determine the rate of evaporation (and steam-drum size) that feedwater conditions permit.

"4. Select the most efficient heating surface (boiler, waterwalls, economizer and/or air heater) that draft, coal cost and fixed charges will permit."

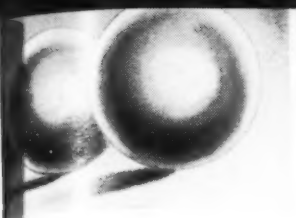
Since that article was written the development of apparatus has been such that the cost of high-efficiency equipment is not much greater than for moderate efficiency. We may start our preliminary design with these two assumptions:

1. For 20,000 lb of steam per hr, or less, and for seasonal service as in building heating, we may use natural draft, low rates of evaporation, 7 lb per sq ft maximum, with no economizers or air heaters and a unit efficiency of 75%.

2. For larger capacities we should use induced draft and boilers with economizers or air heaters, or both. Combined boiler and furnace efficiencies should run from 82 to 86%, say, 84%.

Of course there are many border-line cases, but these develop *after* the preliminary study has been made.

With those assumptions we may estimate the maximum rate of fuel burning and proceed in the above order. It is well to select the furnace for the worst fuel the local market offers. Or design for the normal coal, check performance with the poor coal, and strike a compromise. With this method we cannot design a new boiler but it will avoid the confusion of analyzing many proposals.



# Individual Design Features Suit Each Ball Bearing to Its Job

***Here's why ball bearings operate successfully under the many conditions to which they are applied. C W Pearsall, vice-president, Ahlberg Bearing Co, describes ten designs commonly used, giving applications to which each type is best adapted***

▶ BALL BEARINGS ARE BUILT with features that fit specific applications. Some designs take heavy radial loads, others thrust loads, while still others take a combination of radial and thrust. Bearings also have grease plates, felt seals or other devices that suit them to certain applications.

An annular ball bearing has a groove or annulus in its inner and outer ring in which the balls ride. The race groove's radius is slightly larger than that of the balls. This raceway provides an elliptical contact area between race and balls, which gives a greater radial-load capacity than would a flat raceway, and permits such a bearing to carry thrust as well as radial loads.

Here are ten designs in general use:

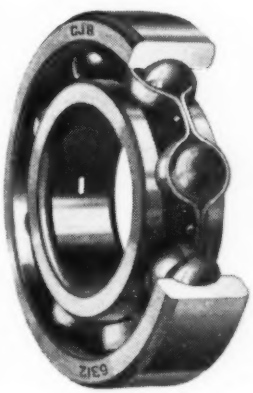
*Deep-groove bearing.* Most popular single-row bearing and most flexible in use is the Conrad, Fig. 1 and 2, variously called deep-groove, non-filling slot, no-notch or continuous-raceway. It is also known as a radial design because the line through points of contact between balls and raceways is perpendicular to the shaft, Fig. 2. It carries high thrust loads in either direction as there is no filling notch and the grooves are deep. Under thrust loads, however, contact line tends to shift and balls ride up on the raceway's sides. Radial capacity is 75 to 80% of that for a maximum bearing, described below, but the deep-groove is better suited to take misalignment.

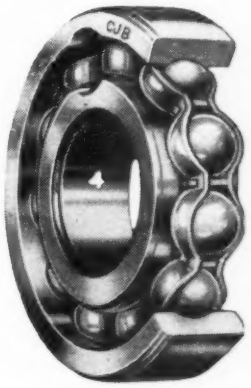
This type contains as many balls as can be inserted by the Conrad assembly method (named for its inventor) Fig. 3. To permit insertion of balls, inner race of bearing is moved to one side as shown. Sometimes by slight distortion of outer ring an extra ball can be put in. After assembly, races are centered and balls equally spaced in them. Then the retainer is assembled around the balls and the bearing is ready for inspection. This design is suitable for: (1) moderate radial loads (2) moderate thrust loads in either direction (3) high speeds.

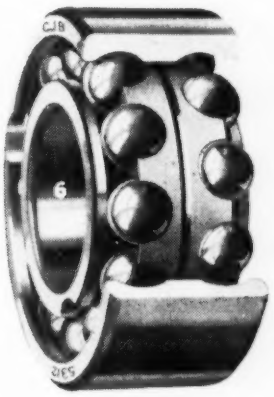
*Maximum bearing.* This single-row radial bearing, Fig. 4 and 5, is also called filling-notch, filling-slot or loading-groove. For high radial capacity this de-

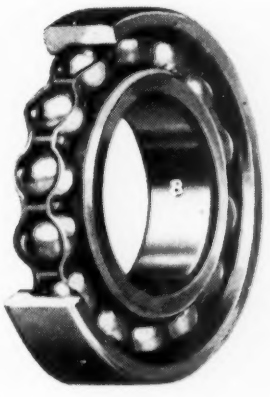
(*Continued on page* 98)

**Fig. 1 and 2—Single-row deep-groove or Conrad assembly ball bearing. Fig. 3—In a Conrad assembly, bearing contains as many balls as can be inserted by method shown. Fig. 4 and 5—Single-row maximum or filling-notch bearing has maximum number of balls, while still leaving space for retainer. Fig. 6 and 7—Double-row filling-notch bearing is narrower than pair of single-row bearings but has slightly less capacity. Fig. 8 and 9—Single row angular contact bearing in which ball contact is at an angle so bearing can carry high thrust loads in one direction, but none in other**



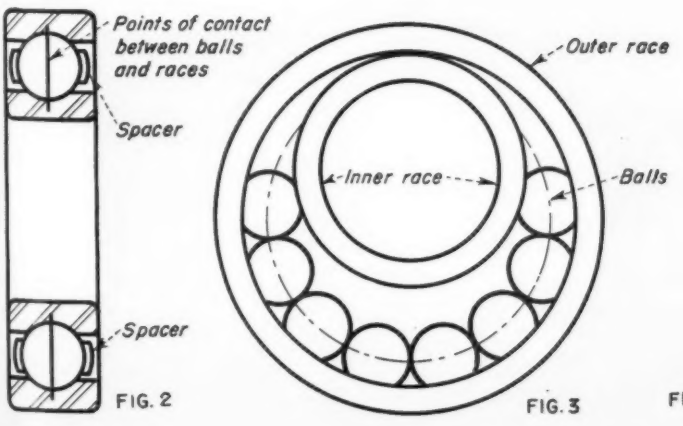



FIG. 2 FIG. 3

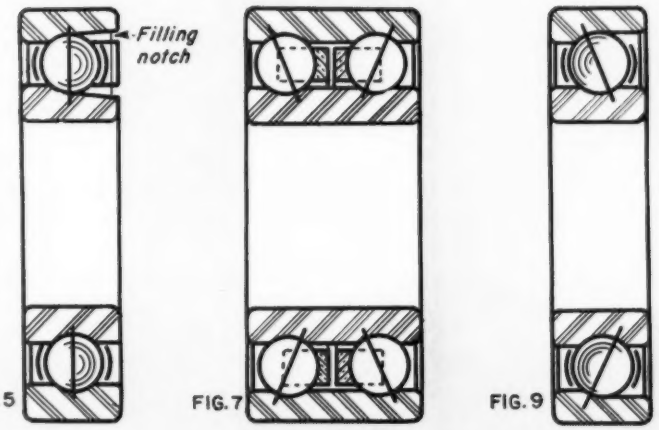



FIG. 5 FIG. 7 FIG. 9

# Many recent installations use Riley-Harrington

**The following installations use Riley-Harrington Stokers for burning midwestern coals**

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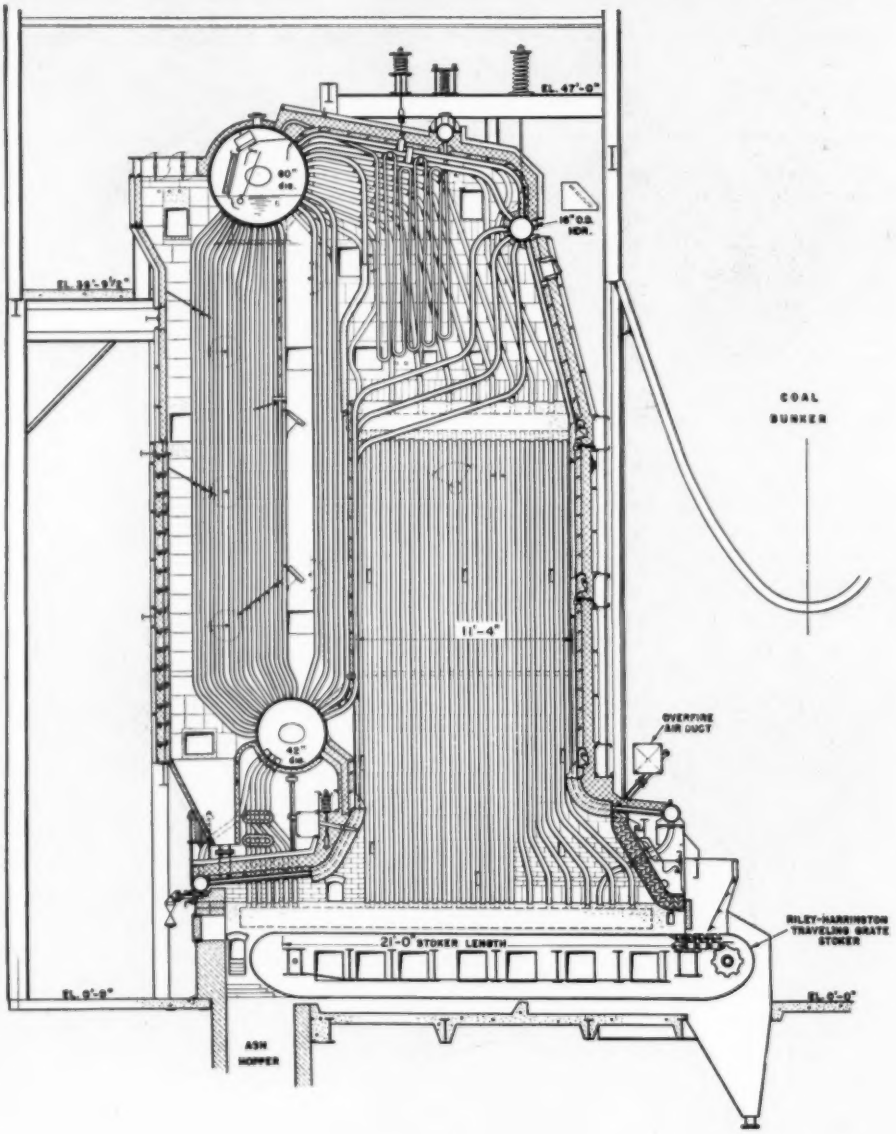
Ohio Salt Co.
DesMoines Water Works
Sherwin Williams Co.
Curtiss-Wright Corp.
White Motor Co.
A. E. Staley Mfg. Co.
Standard Oil Co.
Ohio Match Co.
Industrial Rayon Co.
Dow Magnesium Corp.
Owens Corning Fiberglas Co.
Iowa State College
Independent Towel Supply Co.
Colonial Salt Co.
Ford Motor Co.
Culver Military Academy
Diamond Magnesium Co.
White Sewing Machine Co.
W. S. Weiant & Sons Co.
City of Salem, Ill.
Agar Packing & Provision Co.
Pettibone Mullikin Co.
Terre Haute Paper Co.
W. T. Rawleigh Co.
City of Metropolis, Ill.

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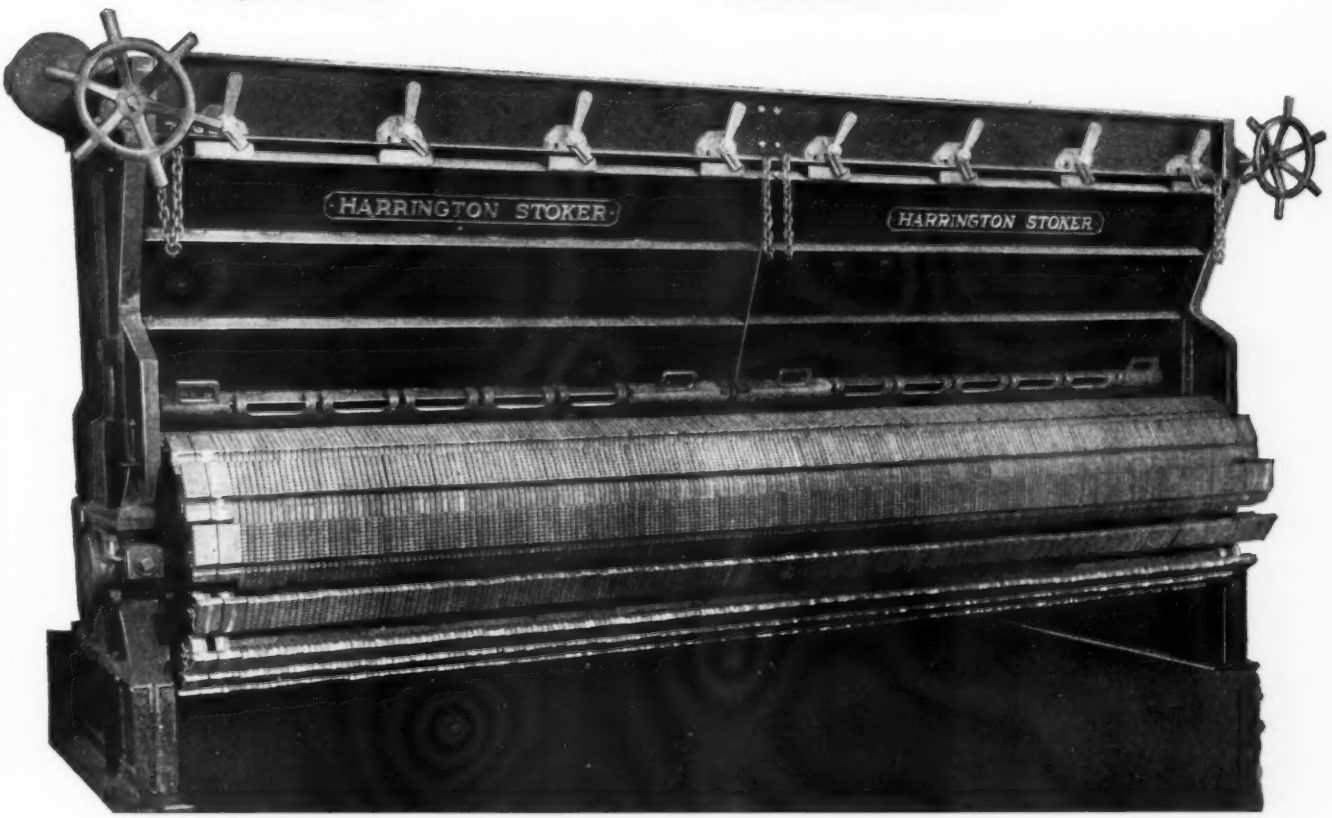
# Stokers for burning midwestern coals....

When used in conjunction with a properly designed furnace in which overfire air is utilized to provide adequate furnace turbulence, Riley Harrington Stokers are producing unusually satisfactory results when burning low grade midwestern coals. Such a unit was recently placed on the line by A. E. Staley Manufacturing Co. A cross sectional view of this installation is shown on the opposite page.

The following features of the Riley Harrington Stoker contribute to its satisfactory trouble-free operation when burning midwestern coals.

1. Undisturbed fuel bed
2. Continuous ash discharge
3. Uniform air distribution
4. Complete air control by compartments
5. Positive side air seal
6. Roller chains—no sliding friction
7. No moving parts in fire
8. Grate surface subject to no mechanical stress

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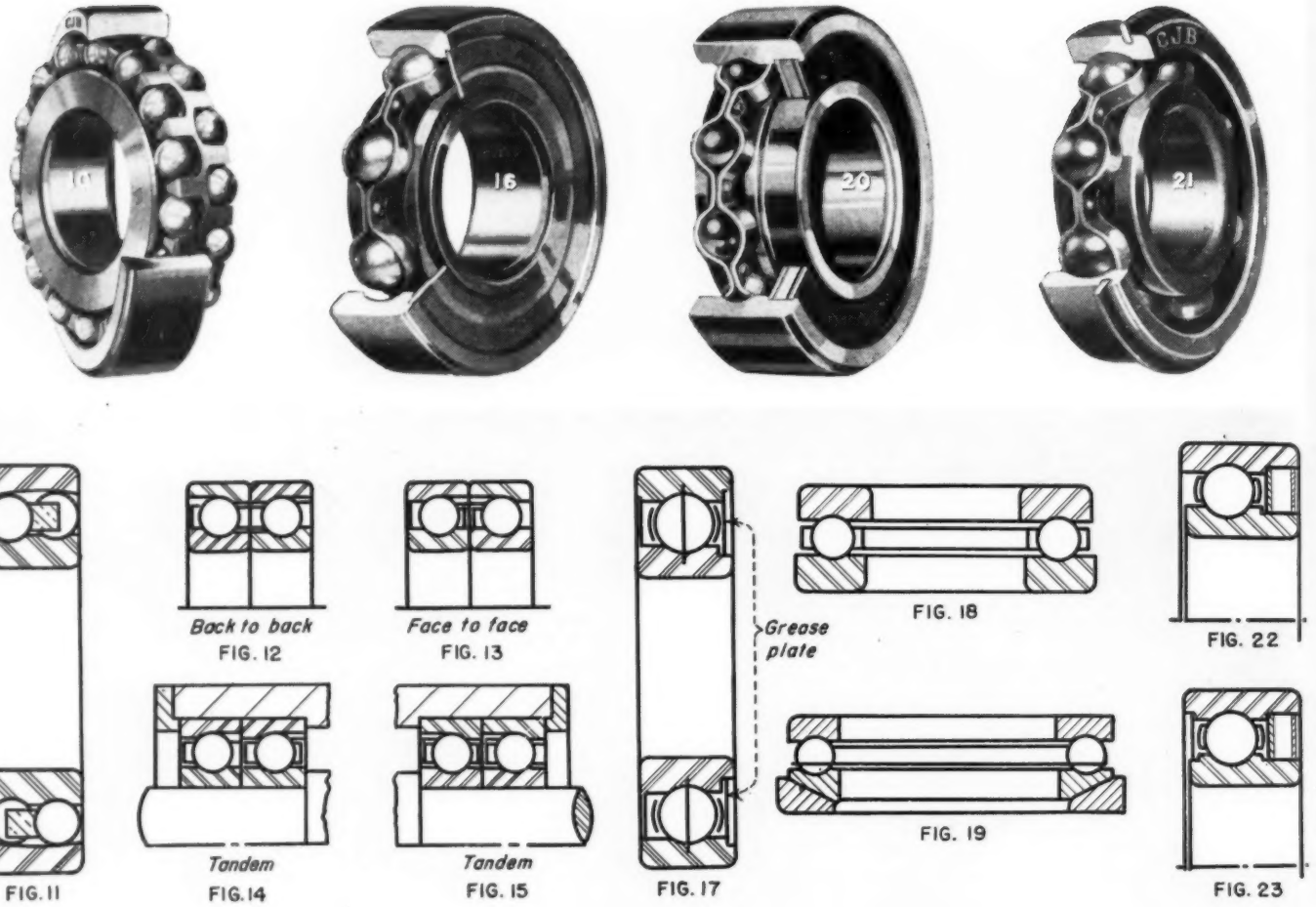


**Fig. 10 and 11—Inner ring of self-aligning bearing has double raceway; outer ring has a spherical inner surface. Fig. 12 to 15—Matched pairs of angular contact bearings mounted back to back, face to face, and in tandem respectively. Fig. 16 and 17—Single-row ball bearing with grease plate to exclude large particles of foreign matter from bearing. Fig. 18—Ball-thrust bearing. Fig. 19—Self-aligning ball-thrust type. Fig. 20 and 22—Felt-sealed ball bearing. Fig. 21—Snap-ring ball bearing. Fig. 23—Bearing with felt seal on one side and grease plate on the other to increase sealing**

sign has the maximum number of balls that can be used and still have space for a retainer. This requires cutting a notch in one side of each race, Fig. 4, through which the extra balls are inserted. As this notch removes part of the raceway's sides, it is not suitable for high thrust or pure thrust loads. Maximum bearings are suitable for: (1) heavy radial loads (2) moderate thrust loads in either direction (3) moderate speeds (4) combined radial and thrust loads.

*Double-row bearing.* As the name suggests, inner and outer rings have two grooves and there are two rows of balls, Fig. 6 and 7. This bearing is slightly narrower and has slightly less radial capacity than two single-row bearings. Ball contact is at an angle, Fig. 7, as in the angular-contact bearing, Fig. 9, described below. Thrust capacity of a double-row bearing is high, being equal to that in the radial direction. It is suitable for: (1) heavy radial loads (2) heavy thrust loads in either direction (3) great axial and radial rigidity (4) moderate speeds (5) combination of heavy radial and thrust loads.

*Angular-contact bearing.* This single-row type is also known as a radial-thrust design, Fig. 8 and 9. Outer ring has a deep shoulder on one side, and on the other a shallow one instead of a notch. Design permits putting a maximum number of balls in the bearing when heat expands its outer ring. Ball contact is at an angle, Fig. 9, so the bearing can take a high thrust load in one direction but none in the other. It is used where thrust is all in one direction and radial load is heavy. Usually it is mounted with another angular-contact bearing. The latter is on the shaft's other end and mounted in opposition to its companion to take thrust load in either direction. Applications are: (1) heavy radial combined with heavy thrust loads (2) heavy thrust loads in one direction (3) great rigidity (4) loads where adjustment is required (5) high speed.

*Duplex bearing.* Two single-row angular-contact bearings mounted as a unit are called a duplex mounting. This type is arranged in matched pairs back to back, Fig. 12; face to face, Fig. 13; or in tandem, Fig. 14 and 15. Either of the first two arrangements is used where shaft deflection must be held to a minimum, and great rigidity and precision are

(*Continued on page* 140)

# HOUSING CAN COST TOO MUCH

EVERYONE in the United States wants our people, and particularly our war veterans, well housed quickly. Almost everyone, we believe, likes the vigor and imagination with which Wilson W. Wyatt, the housing expediter, is going about the job of mobilizing our housing resources.

No one, however, wants the veterans, or anyone else, to get a lot of severe economic headaches along with the housing. As it stands, the emergency housing program runs unnecessary risks of having such results.

Here are the reasons:

1. The principal opportunity the program offers to the veteran is that of buying a high-cost house where a chance to rent would, more often than not, meet his needs much better.

2. At the worst possible time, the program adds substantially to the dangers of a runaway inflation of the sort that inevitably ends in a crash.

3. Little is done to try to reduce the arbitrarily high costs of building, such as those resulting from restrictions imposed by labor unions and antiquated building codes.

4. By giving overriding priorities to unattainable goals of home construction, the program endangers a volume of industrial construction necessary to sustain full employment.

### Needs of Veterans

First on the needs of the veterans. What many, if not most, veterans need is a chance to rent a place at a reasonable rental while they are getting shaken down in their postwar careers which in many cases are inevitably unsettled at this time. Essentially, what the "Veterans Emergency Housing Program" gives them is a chance to buy, for about $6,000, a house built along conventional lines and padded with much unnecessary labor and material cost.

But what are the alternatives? There are at least two. One is to put far more emphasis on more effective use of existing housing than the Wyatt program has thus far. The other is to see that the proportion of new rental units is much stepped up.

Incredible as it may seem, there are at present more than 2,000,000 vacant dwellings in the United States. Many of them should be demolished. But many permit of relatively satisfactory temporary use. Many more single dwellings can readily be converted into comfortable multiple dwellings. The emergency program assumes that only 350,000 dwelling units can be provided this year by these expedients, but it does not seem unreasonable to assume that this figure might be doubled by a vigorous drive. The result would be a better balanced emergency housing program, because it would provide more rental housing immediately and save critical building materials.

Of the new housing units contemplated by the Wyatt program, it is estimated that only about 20 per cent will be for rent. Before the war more than half of the homes in the United States were rented. That means that unless the Wyatt program is to create little less than a revolution in the terms on which homes are occupied, it must be revised to include a much higher proportion of rental units.

To secure the result in the face of present high building costs special inducements will be required. They might be provided by allowing accelerated tax amortization of, say, half the construction cost over the next five years, together with rent ceilings high enough to make this form of investment attractive. This would, of course, call for higher rents, but the actual price to the veteran, in woe as well as money, might well be much less in the long run than if he bought an over-priced house now.

### Too Easy To Pay Too Much

One of the mysteries of the Wyatt program is its general emphasis on measures to increase the supply of money with which to buy houses when the demand for houses is already at an all-time high. Some veterans may need special financial help, but the plan to give 90-95 per cent mortgages generally on new homes is not only unnecessary but positively dangerous. By providing up to $3.5 billions of government-guaranteed credit for homes this year, and almost twice as much in 1947, the program will release an equivalent amount of individual savings to create further demand for goods and services. All that such generous mortgage terms will accomplish with certainty is a dangerous lengthening of the odds that we will not avoid a boom and bust cycle of inflation.

If building codes were brought up to date and arbitrary union working restrictions were eliminated, the way would be paved for reductions in the price of standard houses which, it has been estimated, might run as much as 20 per cent. This would both give the buyer of a new house a far better run for his money, and also reduce the inflationary pressure created by the super-generous credit arrangements involved.

Getting anything done along this line is difficult, particularly because the restrictions are imposed by tens of thousands of separate localities and organizations. Some headway is being made. The local emergency housing committees being set up under the Wyatt program provide a means of doing much more. Far more steam must be put behind this aspect of the program, however, if its greatest potentiality for permanently constructive accomplishment is to be realized.

### Crippling Essential Industrial Production

The goals set for emergency housing construction —1,200,000 new homes started this year and 1,500,000 started in 1947—are higher than any qualified authority thinks can be met without crippling other essential construction. The reasons commonly assigned for such optimistic goals is that they are inspiring to those in the industry and soothing to those who want something tremendous done about housing.

Under normal circumstances, relatively little damage might be done by such excessive goals which are a common feature of most Washington programs trying to elbow their way to the center of the national stage. However, the emergency housing program carries with it top priorities for the materials to be used. Consequently, other essential construction will have to get along on whatever share of critical building materials will be left after all demands of home builders have been satisfied.

The Civilian Production Administration estimates that output of important materials will fall far short of needs. It forecasts a 15 per cent deficit in lumber, 18 per cent in bricks, and 52 per cent in cast iron radiators. Hence, unless building materials output can be stepped up far more rapidly than now seems possible, a prohibitive squeeze will be put on industrial building to provide the materials needed for the Wyatt program. This would complicate unbearably the problems of sustaining full employment and getting the flow of production so important in avoiding the boom and bust route.

### Perspective on the Housing Shortage

What is needed is an aggressive drive to get full production of building materials as rapidly as possible. Such a drive should concentrate on measures aimed at helping the industry remove the obstacles to all-out production rather than on such measures as the subsidy plan which seems quite likely to succeed only in enmeshing the industry in more government controls. After making due allowance for the materials outlook and the needs for essential non-housing construction, housing goals should then be set as high as feasible. As matters stand, by setting construction goals before feasible material goals are determined, the cart is put before the horse.

There can be no doubt about the acuteness of the housing shortage and the necessity of a program commensurate with the magnitude of the problem. It also remains true, however, that the housing shortage for the nation as a whole is not quite as desperate as those who want the country to drop everything and go to building houses would have us believe.

During the war 3½ to 4 million new dwelling units were built or created by remodelling in other than farm areas. The number of families living in such areas increased by less than 3½ million. Even though some of this housing was located in remote places as an adjunct of war production works, the wartime increase permitted a margin for more housing per family at this time. Indeed, it has been estimated that the rate of doubling up is only about one-third as great as in 1940. The margin did not begin to suffice, however, to meet the needs of those millions of people particularly in the lower income groups who, thanks to rapid increases in income, can afford to have and insist upon having better housing than they have ever had before.

A rising standard of income which makes possible a new standard of housing for many people is a fine thing. Above all, it is important to see the veterans get the best possible break in housing.

### But Housing Can Cost Too Much

The Wyatt program has many good features. The emphasis on prefabrication, though perhaps overoptimistic, is hopefully modern. The emphasis on local collaboration in solving housing problems which are inevitably in large part local should lead to permanently valuable results. The vigorous mobilizing of 300,000 temporary dwellings to meet at high speed some of the most desperate shortage is all to the good.

The main trouble with the program is that it does not pay enough attention to the economic havoc which may be created in the process of trying to meet its excessive goals. As a nation, we should be and are willing to pay a high price to get adequate housing. But the price will be too high if we:

1. Give the veteran a bad bargain by selling him an over-priced house.
2. Cripple industrial production needed to create good jobs for veterans, and
3. Touch off a disastrous inflationary sequence in the process.

These pitfalls can be avoided. All of us, including the veterans, have a common interest in seeing that they are avoided.

*President, McGraw-Hill Publishing Co., Inc.*

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▶ RECORD-BREAKING ATTENDANCE marked the ninth Midwest Power Conference, held at the Palmer House, Chicago, April 3-5. For the first time the sessions extended over three full days instead of two, thus making room for 70 speakers, 17 sessions, three luncheons and the annual "All Engineers' Dinner."

Arrangements and background followed the long-established MPC pattern: sponsorship by leading Midwest technical schools headed by Illinois Institute of Technology, close cooperation with Chicago sections of ASME, AIEE and other engineering societies, and papers on every phase of power progress. Cooperating educational institutions included Iowa State College, State University of Iowa, Michigan State College, University of Wisconsin, Northwestern University, University of Michigan, University of Illinois, Purdue University and University of Minnesota. As usual, Prof Stanton E Winston, Illinois Institute of Technology, was conference director, assisted by C A Nash, conference secretary.

Dean L E Grinter of Illinois Institute presided at the opening session, James D Cunningham, president of Republic Flow Meters Co, made the address of welcome, and Dean T R Agg, Iowa State College, responded for the cooperating schools.

### *Atomic-Power Possibilities*

In the first engineering paper, Philip Swain, editor of POWER, reviewed the fundamentals of atomic power. Although natural uranium costs only about $2.00 per pound (prewar), and has the energy equivalent of 10 tons of coal, Swain warned against assuming that uranium could therefore compete with coal costing 20¢ per ton. He mentioned present great cost of purifying natural uranium, of concentrating U235 and of removing "poison" fission products accumulating in atomic piles. He suggested, however, that nuclear "fuel" will eventually find commercial applications, probably for large power stations and ships. A long-range possibility, he said, is direct conversion of atomic energy into electricity without a heat-power conversion.

The great immediate concern, Swain declared, is danger from atomic weapons. He made three points: (1) In five years, more or less, all industrial nations will know how to make these weapons. (2) They will be able to obtain needed raw materials and afford the cost of producing atomic weapons in devastating quantities. (3) No effective technical defense against atomic weapons is likely to be discovered. He concluded that the nations of the world will face constant deadly peril until they achieve full international control over atomic weapons. If these safety measures succeed, he said, the world may look ahead to an eventual golden age of atomic energy.

Partly lifting the veil of secrecy that has shrouded most of the uranium processing at the famous Oak Ridge plant, R R Wisner, assistant chief electrical engineer, Stone and Webster Engineering Corp, revealed the character of the electromagnetic separation plant designed and constructed by his company.

Streams of uranium ions are shot into a vacuum chamber between poles of colossal electromagnets. In this intense magnetic field the ions follow circular paths, smaller in radius for U235 than for U238. Separate pockets catch the two isotopes, thus achieving the desired separation of U235 from U238.

### *Oak Ridge Electromagnets*

The Oak Ridge work done under Stone and Webster totaled $427,000,000 not counting the $400,000,000 value of sterling silver borrowed from the Treasury for use instead of strategic copper in magnet windings. Each electromagnet at Oak Ridge is 250 ft long and contains thousands of tons of high-permeability steel. Winding insulation of a single magnet weighs 40 tons.

Steam-station power generation was highlighted by papers on the subjects of

**At luncheon on the opening day of the conference: Alf Kolflat, partner and chief engineer, Sargent & Lundy, who spoke on "Problems in Power-Plant Design"; J C Marshall, Chairman, Chicago section ASME; J R Michel, Commonwealth Edison Company; and standing, Otto de Lorenzi, of the Combustion Engineering Company**

feedwater treatment, operating experiences and troubles, design problems, capacity forecasting, steam-generator automatic controls, smoke abatement, extraction-turbines and fuel handling.

In a frank discussion on the engineering aspects of feedwater treatment Leo F Collins, chemical engineer, The Detroit Edison Co, stated that a complete technology in this field has not yet been developed. Most *recurrent troubles* are caused by misapplication of treatment method rather than by voids in the science of water chemistry. Treating systems should be designed not only for the physical requirements but also for the level of talent that will be available to operate them. He listed frequent mistakes of the past as (1) preliminary design studies being omitted or superficially conducted (2) inadequate treating capacity (3) insufficient operating guides, and (4) "stuffing" treating equipment into the plant. He stressed that all plants can well afford the "cost" of competent technical supervision.

### *Feedwater Treatment*

In "Reduction of Turbine Blade Deposits by Water Conditioning," by M E Fitze and F H Long, Wisconsin Electric Power Co, the authors related the experiences with unconventional water treatment in a high makeup plant. In their company's Commerce Street plant in Milwaukee a 35,000-kw 1200-psig 900-F turbine is bled to supply steam to their district heating system. This operation causes the plant to use 60% makeup.

At 1300 psig phosphate was found to interfere with silica removal by magnesia. A year's experience with internal treatment of magnesium oxide for silica removal in the absence of phosphate has shown no detrimental effects other than the proportionate increase in boiler sludge. Insoluble silica deposits in the turbine have been reduced.

Internal treatment for 8½ months with barium chloride for reducing superheater clogging by sulphate has shown no detrimental effects other than the proportionate sludge increase and the formation of feed-line deposits at the point of injection. Organic contamination of the boiler water through decomposition of carbonaceous zeolite at 1300 psig produced turbine clogging by water soluble deposits.

### *Practical Power-Plant Design*

Alf Kolflat, partner of Sargent and Lundy, consulting engineers, addressed the joint ASME luncheon, stressing the practical angles of power-plant design and operation. Changing times, he said, are reflected in the attitude of the newer operating men toward the laborious and dirty plant chores such as cleaning boilers and loosening frozen coal. In this push-button age we must seek cleaner and easier ways to get this work done.

P S Dickey, chief engineer, Bailey Meter Co, in his paper "Automatic Control of Steam Generators and Auxiliaries," estimated that automatic means controlled about 50% of bituminous coal burned under stationary boilers. He pointed out that quality of a control system depended not only on the nature of the mechanism but also on (1) the adaptability to control of the fuelburning equipment, pumps, fans and valves and (2) the arrangements of the control system. Dickey described the different types of boiler-feed regulators needed for the various boiler designs (1) self-operated single-element suitable for large drums capable of carrying large changes in water level (2) relay-operated single-element for medium-sized boilers operating at medium pressures (3) relay-operated two-element for medium-sized boilers operating with small load fluctuations and (4) relay-operated three-element for large boilers operating at high pressures and with highly fluctuating loads.

### *Future Needs for Power*

Howard P Seelye, The Detroit Edison Co, discussed the difficulty of estimating the need for future power-generating capacity in his paper on "Future Requirements and Trends in the Use of Electric Power." Adequate capacity must be made available to carry future loads but not at the expense of incurring excessive fixed charges on overexpanded plant capital investment. This hinges on assuming a realistic attitude in considering facts and probabilities. A review of the various power demands attributable to new or improved appliances for home use, and additional commercial and industrial needs, was thoroughly treated. Various methods of calculating short- and long-term trends in peak demand can be used as a check against each other.

### *Industrial Turbines*

Pointing out the enormous number of types of industrial steam-turbine units made for industrial use, L E Newman, General Electric Co, saw potential benefits from efforts towards standardization as stated in his paper on "Extraction Turbines For Industrial Power." This can come about by providing fewer ratings, less variation in initial steam pressures and temperatures and fewer variations in generator voltages. The acute need of fitting the turbine to the job has outweighed other considerations. Designs of remarkable flexibility are made from standard parts, but despite this it is felt that cheaper power can be ultimately obtained by striving for standardization.

In a paper on "Grounding Industrial Power Stations," by R L Witzke, Westinghouse Electric Corp, the advantages of grounded versus ungrounded operation of power systems for industrial plants

**Members of gas-turbine panel: L N Rowley, managing editor of Power; J I Yellott, director of research, Locomotive Development Committee; D L Arm of Iowa State College, chairman of the first gas-turbine session; Dr J T Rettaliata, of the Illinois Institute of Technology; and B G A Skrotzki, assistant editor of Power**

were compared. In conclusion some form of grounding is generally recommended.

Dealing with the problems of industrial power plants, C M Garland, consulting engineer, traced general trends in the small-plant field and pointed out the differences between plants of 25,000 kw, or less, supplying power and process loads, and larger plants designed for production of electricity. Citing design improvements in small boilers and in control equipment, Garland concluded that the skilled designer can produce a small steam power plant that need not take second place in technical excellence to its larger fellows.

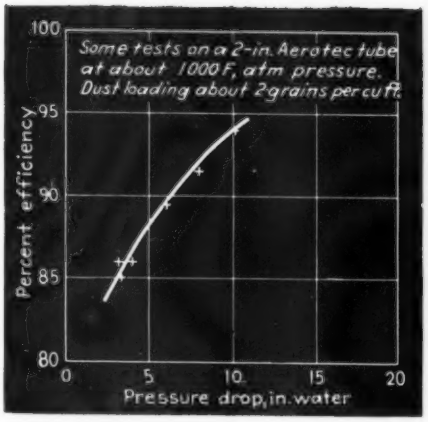
### *Small-Plant Smoke Problems*

Carroll F Hardy, chief engineer, Appalachian Coals, Inc, cited the results of surveys of more than 2200 installations in a paper on "Smoke Abatement in Small Power Plants." Of all the plants surveyed, only eight were in first-class operating condition. Fifteen percent had minor defects and were well operated. Two thirds of the plants suffered from operational difficulties, with incorrect firing heading the list. Faults included: lack of firing method, unnecessary stirring of fire, overloading the firebox, trying to force a cold boiler, poor maintenance and housekeeping, and accumulations of soot and flyash in gas passages, breechings and chimney.

Common failings leading to smoke trouble include (1) lack of means whereby the fireman can see the stack to detect smoke and (2) assigning the fireman so many duties that he has no time for proper operation and maintenance. In Hardy's opinion, only about 25% of combustion-control and metering equipment in plants surveyed was being operated properly. Many instruments were disconnected or couldn't be read, and others had been tampered with so results were no longer dependable. Another common source of difficulty lies in lack of cooperation between the boiler room and departments using steam. This means unnecessarily heavy and rapid loading of boilers and combustion troubles.

### *Better Mixing—Less Smoke*

Many plants, Hardy said, could be taken out of the violator class by provisions for better mixing of furnace gas and air. While use of steam or air jets is not a cure-all, it does solve many cases of overloaded or improperly installed equipment. For best results with jets, a carefully engineered installation is essential. Valuable information on overfire jets can be found in "Technical Paper No. 7," published by Bituminous Coal Research, Inc, Pittsburgh, which is now being revised and will be available soon.




**Test curve for single cyclone separator tube. A battery of these will be used for flyash removal on coal-burning gas-turbine locomotive under development**

After pointing out that proper firing methods are just as important in mechanically fired plants as in hand-fired ones, Hardy discussed in some detail the weaknesses uncovered by the survey. He concluded by stating that few plants have any excuse for making smoke, and the improvements necessary to overcome smoking usually show a material saving in fuel and insure more reliable operation.

### *Steel-Mill Power Needs*

In a paper on electrical power supply for steel-mill loads, F W Cramer, Carnegie-Illinois Steel Corp, presented general data on type of loads, and outlined the procedure for estimating the load of a mill, the demand, the balance between energy supplied from waste fuel and that from purchased fuel, and power costs. He concluded by working out several equipment combinations to supply this estimated load.

A J Stock, president, Stock Engineering Co, examined in some detail the requirements for under-bunker conveyors. They serve to feed coal to firing equipment where gravity feed cannot be employed, to reclaim coal from dead spots between main bunker outlets, to reduce frequency of coal-loading operations by making coal not needed by one boiler available to others, and to empty any bunker section quickly and easily for repairs or fire prevention. He pointed out that under-bunker conveyors must be designed to suit individual requirements and presented a variety of layouts to illustrate his points.

Possible arrangements of under-bunker conveyors include use of elongated coal-scale feed belts, working on one or more bunker outlets, of triple valves to direct coal flow by gravity to the coal scale or to a conveyor, which makes coal from any one bunker section available to any boiler. Use of a swing switch permits making under-bunker conveyors automatic. To point up the importance of sound design, Stock showed a number of examples of poor layouts.

In conclusion, he listed 17 requirements for good under-bunker design, among them: provision of adequate sectional areas and plate thicknesses, dust-tight construction with suitable access doors, reliable and properly located automatic controls, proper alarm and safety precautions. Each conveyor should preferably be fed from only one outlet at a time and should be designed for point to point transportation rather than circulation. Equipment should be of ample size, and design should prevent segregation.

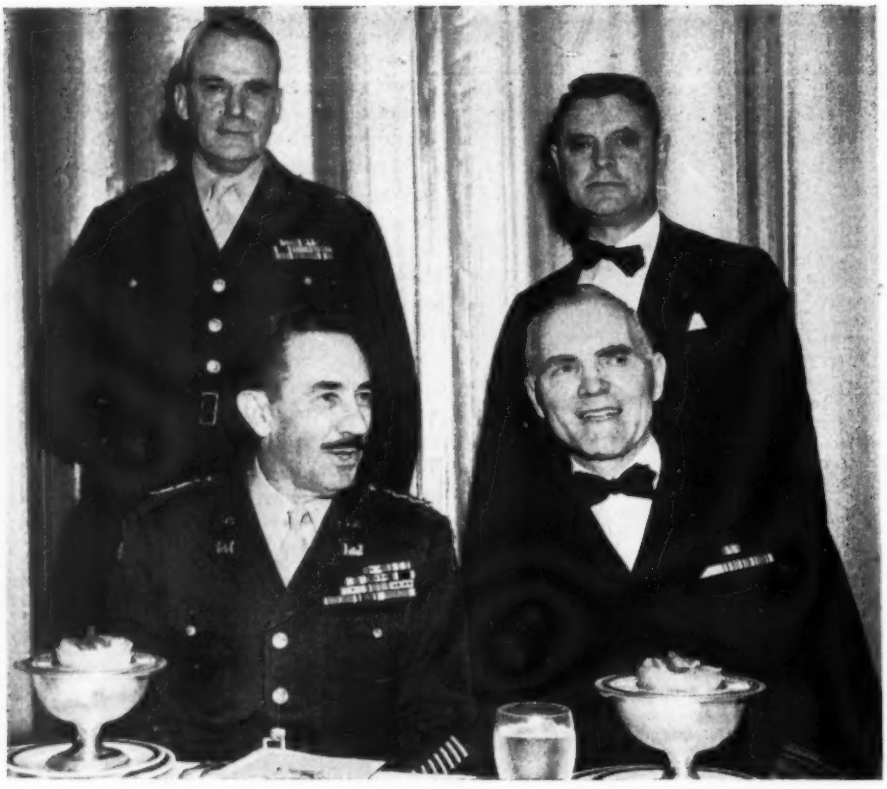
### *Charts for Gas Turbines*

Steadily growing interest in gas-turbine plants for power generation was in evidence by the two well-attended sessions devoted to this subject. John T Rettaliata, Illinois Institute of Technology, contributed to the art of analyzing gas-turbine cycle performance by his paper on "Linear Relationships in Gas Turbines." The author, a leading authority in the field, presented a set of 19 charts, composed of straight lines, which facilitate calculation of gas-turbine performance factors without need for further reference to thermodynamic tables. Some abitrary modifications have been made to confine the charts to straight lines, but the resulting error in final answers is less than two percent, which is of a satisfactory order for the major portion of work done in this field.

### *Gas-Turbine Development*

"Where the Gas Turbine Stands Today," by L N Rowley and B G A Skrotzki, managing editor and assistant editor of POWER, reviewed the development and commercial applications of the gas turbine up to the present time. Starting with diagrams of simple, regenerative, multistaged and free-piston-compressor gas-turbine cycles, their performance behavior in terms of thermal efficiency, air rate, work ratio and pressure ratio was reviewed. Effects of engine and compression efficiencies, turbine-inlet temperature, regenerator effectiveness and multistaging were demonstrated. With the performance behavior as a background the construction of the actual cycle components was examined, such as compressors, turbines, regenerators, air heaters, free-piston compressors or gas generators, combustion chambers, air heaters and load-control arrangement.

Firm gas-turbine applications are realized for supercharging internal-combustion engines, pressurized boiler furnaces, chemical processes, and as prime movers



**At the All Engineers' Dinner: (seated) Lt Gen R A Wheeler, USA, Rear Admiral W G Taylor, USN; (standing) Brig Gen George Armstrong, David Levinger**

for military aircraft. Major development programs are under way in the railroad, marine and stationary fields.

Stressing the importance of wartime advances in materials and design, J R Carlson, Westinghouse Electric Corp, reviewed the position of the gas turbine in industry. Speaking particularly of central stations, he cited the difficulty of competing with large steam-turbine plants of high efficiency unless the cost of the more complex high-efficiency gas-turbine plant can be reduced. This might be done, he said, by increasing rotational speed to permit smaller units, or by one or another closed-cycle arrangement, which would also achieve the same end by operating at high pressure.

### *Closed-Cycle Gas Turbines*

In discussing the fully closed cycle, Carlson cited the many advantages, but pointed out that these are offset by the apparent high cost of the air heater. On the other hand, the semiclosed cycle uses direct firing and hence eliminates the air heater. With either closed or semiclosed cycles, units of large size can be built.

The gas turbine offers a valuable way of building compact high-power locomotives, Carlson said, particularly if solid fuel can be burned. He outlined research work under way in this connection. Summing up, he ranked gas-turbine applications in this order: (1) aircraft (2) locomotives (3) ships and, finally, (4) central stations, for peak and standby.

With emphasis on the need for ability to burn coal in gas turbines, the paper on that subject by J I Yellott, director of research, Locomotive Development Committee, Bituminous Coal Research, Inc, proved of particular interest. After reviewing gas-turbine characteristics and applications, he demonstrated the economic advantages accruing from ability to burn coal. To do this requires devising means for pulverizing and burning coal in limited space conditions, and removing solid matter from combustion products to protect turbine blades. In the locomotive design proposed, a special screw feeder carries coal to a crusher. The coal will probably be dried by waste heat at this point, and conveyed pneumatically to a pressure tank. Three methods of pressurizing are under consideration: (1) twin tanks (2) lock hoppers or (3) an inclined screw feeder of special design. Pulverization will be accomplished by the coal atomizer (POWER Mid-Dec 1945) which, with an attrition device, produces fuel so fine that 80% will pass a 325 mesh screen.

The combustion chamber will be of the Vortex type (POWER, Aug 1945). It is expected that this combustor will have the needed high rates of heat release and that some flyash removal can be accomplished within the unit. Final flyash removal will be effected by a battery of small cyclone separators. Tests on single tubes at 1100 F indicate that 95% efficiency can be obtained at a pressure drop of about one psi, with virtually complete removal of particles larger than 5 microns. Tests for Allis-Chalmers, made available to the committee, indicate that particles of 5 microns and under are relatively harmless to blade materials.

### *Diesel-Engine Mufflers*

In a session on diesel power, R W Huddle, development engineer, Burgess-Manning Co, presented "Exhaust and Intake Mufflers and Their Effect on Performance of Diesel Engines." Pointing out that while exhaust and intake surges follow acoustic laws in most respects, the amplitude of the surges is many times greater than that of acoustic waves, he then outlined the theory of their behavior. Field analysis of pipe conditions may be made by the sampling manometer, and a number of examples of data obtained by such an instrument were presented. Huddle then examined the surging conditions in intakes, showing the differences from exhaust surges. He concluded by showing results obtained from properly placed mufflers in exhaust and intake systems.

A paper by Ralph Miller, Nordberg Mfg Co, discussed two ways of increasing the work-to-displacement ratio of diesel engines: (1) admitting greater weight of air to the cylinder and (2) reducing temperature of the charge before compression. The first method involves supercharging, or raising intake pressure above atmospheric. If this can be done without increasing temperature of the charge at beginning of compression and without loss of thermal efficiency, increase in indicated mep is proportional to absolute pressure at beginning of compression. Under these conditions cycle temperatures do not increase and heat stresses remain the same. Substantial gains in power output can be made by reducing temperature before compression instead of supercharging, according to Miller.

### *Intercooling Necessary*

These analyses lead to the conclusion that to obtain maximum utilization of equipment supercharged 4-cycle engines must be equipped with air intercoolers to reduce temperature of supercharging air to original room temperature or lower. The first intercooled turbocharged engine built for stationary service in this country was installed this year in the municipal plant at Menasha, Wis. Normally rated at 110 bmep, intercooling increases the rating to 130 bmep. At present, intercooling is practicable only where water

*(Continued on page 160)*

# THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER


# Higher Compressor Speed and Larger Pumps Give More Refrigeration

***When process load increased, operating both regular and standby compressors did not provide reserve. But by increasing both units' speed one could carry the load, says John D Constance***

▶ IN A PROCESS for the synthesis of neoprene, acetylene gas must be dried so it contains not more than 0.002 grams of water per liter (dewpoint 26 F). First step compresses the gas to 15 psig and passes it through a watercooled aftercooler, which it leaves at about 85 F, saturated with water vapor. Next step passes the acetylene up through a tower packed with 2-in. black-iron nipples, while 15-F brine sprays down over the packing material. After an interchange of heat and moisture, the gas is relatively dry on leaving the tower. When the brine's specific gravity falls, from moisture pickup, a stronger solution is added to bring it back to full strength. An overflow takes care of the increased volume occurring because of makeup.

Originally the refrigerating equipment consisted of two 236-rpm 5x5-in. ammonia condensing units. Each had a capacity of 5.5 tons when operating at the required 185-psig discharge and 20-psig suction pressure. Condenser water enters at 75 and leaves at 90 F.

These units served a shell-and-tube ammonia evaporator that cools the brine solution, which is recirculated between evaporator and two parallel brine-to-brine

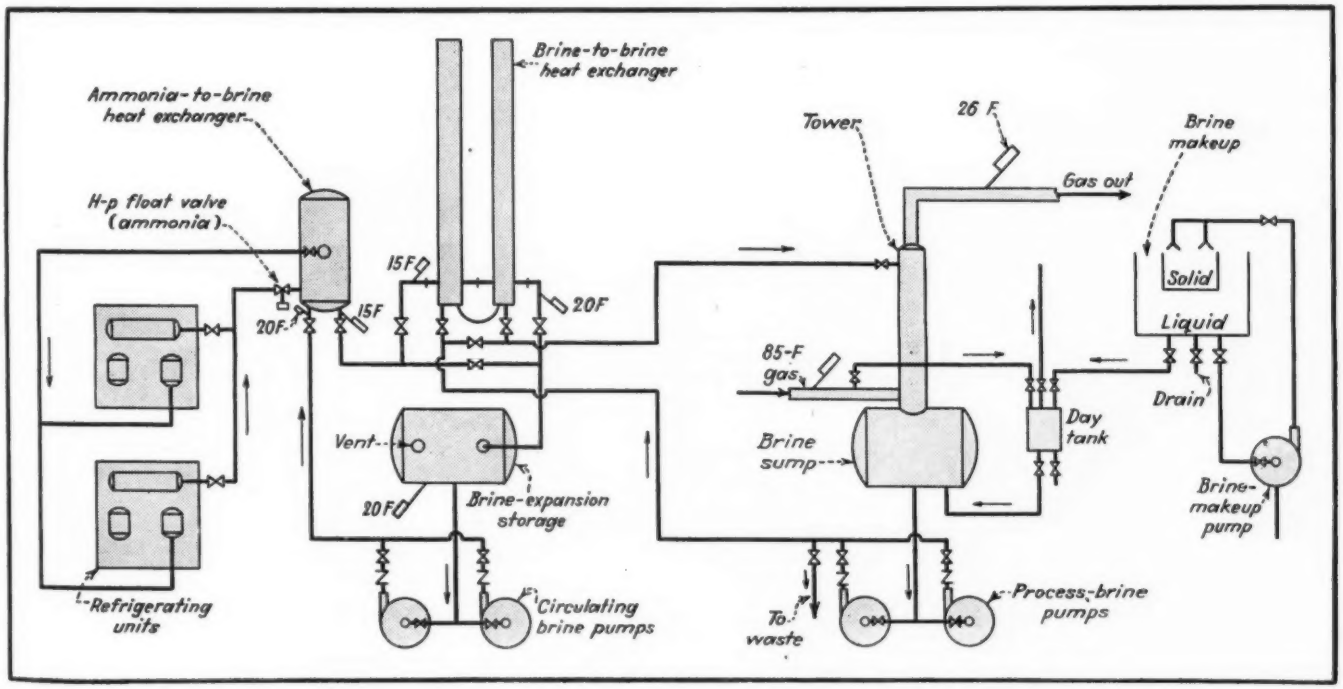



Fig. 1—A shell-and-tube ammonia evaporator cools the brine that circulates between evaporator and two parallel brine-to-brine heat exchangers. The second brine solution goes to process where it cools and dries the acetylene

heat exchangers, Fig. 1. Second brine solution goes to the process tower where it cools and removes moisture from the acetylene.

Each of the original heat-exchanging brine pumps had a capacity of 30 gpm of 1.2-specific-gravity calcium-chloride brine against a 67-ft total dynamic head. One pump acted as standby. The volume of brine that was handled cooled the process brine through a 5-F range from 20 to 15 F. According to heat-load calculations when drying and cooling 18,000 cu ft of gas per hr, the operation of one refrigerating unit handled the load well.

Recently it was necessary to increase the volume of acetylene gas processed, and calculations showed that this would require 7.5 tons of refrigeration. As a trial the two ammonia units were operated in parallel after a larger capacity high-pressure-float valve was installed in the evaporator. Both condensers were equalized to prevent one compressor pulling too much of the common load and to equalize the flow of oil and liquid refrigerant.

### *New Conditions*

Under these conditions total refrigeration capacity was 11.0 tons with both machines driven at 236 rpm by 10-hp 1160-rpm high-starting-torque low-starting-current motors. Both 1½-hp brine pumps were also operated in parallel to increase the brine flow and maintain the cooling range. The manufacturer recommended the new rate to absorb 11.0 tons of refrigeration, but pressure drop through the circuit increased to 135-ft total dynamic head. So actually brine flow never reached 60 gpm (capacity of both pumps in parallel) because of pump characteristics, see curves in Fig. 2.

Decision was then made to operate both refrigerating units in parallel and to replace the existing 1½-hp brine pumps with two 70-gpm units direct-connected to 5-hp motors, keeping one as a spare.

### *Standby for Safety*

Importance of the operation soon showed the advisability of keeping one refrigerating unit for standby service. Since the new heat-load conditions required 7.5 tons of refrigeration, calculations showed that if the ammonia compressors operated at 360 rpm with the same discharge and suction pressures they would develop 8.5 tons each. To secure the higher speed we installed 15-hp motors having starting torque and current characteristics similar to the old ones together with new V-belt drives and pulleys. Because existing across-the-line starters were rated at 25 hp the only change was to replace the thermal protection elements. Equalizing line between the two condensers is now closed during operation.

With both ammonia condensing units operating in parallel at the old speed, brine circulation was 70 gpm and the combined refrigerating capacity was 11.0 tons, but with one machine running at 360 rpm refrigerating capacity dropped to 8.5 tons. This meant a reduced brine circulation to maintain it at the same entering and leaving temperature (in at 20 F, out at 15 F). Calculation for this flow shows:

Basis—Ammonia-brine circuit:

8.5 tons refrigeration with one condensing unit running

Brine on cooler 20 F; off, 15 F

Specific gravity of brine solution, 1.2

Specific heat of brine 0.71 Btu per pound

$W$ = pounds of brine

200 = Btu per min per ton of refrigeration

Weight per gal of 1.2 specific-gravity brine = 10 lb

Striking a heat balance:

$8.5 \times 200 = W \times 0.71 \times (20-15)$

$W = 480$ lb per min or

$\frac{480}{10} = 48$ gpm 1.2 specific-gravity brine

Therefore, 48 gpm instead of 70 would have to be circulated through the ammonia-to-brine and brine-to-brine units.

An investigation of Fig. 3 (characteristic curve for the 5-hp pumps) shows that a flow rate of 48 gpm requires 8.88 brake horsepower. This would overheat the 5-hp motor, even though it could be run 20% above its nameplate rating. Referring to Fig. 2 (characteristic curve for the 1½-hp pumps) 48 gpm imposes a brake horsepower load of 1.44 but develops a head of only 50 ft. Using a basis of 70 gpm against 135-ft total dynamic head, 48 gpm requires:

$$\left(\frac{70}{48}\right)^2 = \frac{135}{X}\ ;\ X = 63 \text{ ft}$$

The piping-system curve passes through the 5-hp pump curve at 70 gpm and 135-ft head, which is indicated in Fig. 3.

### *Overload Setting*

The 5-hp pumps were retained and their flow throttled to a point where the overload-relay heater, selected to accommodate the full-load ampere nameplate rating, allowed continuous motor operation. Flow was actually 60 gpm. Brine leaving the coolers averaged 16 F, whereas dewpoint of the gas leaving the packed tower averaged 28 F, which was acceptable to the processing company.

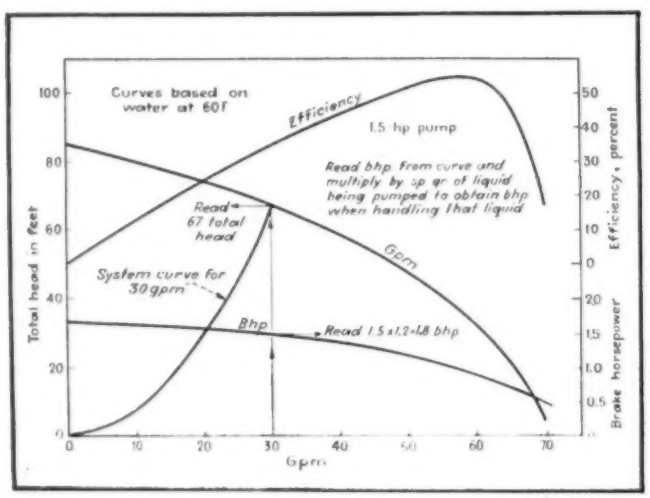

Curves based on water at 60F
Efficiency
1.5 hp pump
Read bhp from curve and multiply by sp gr of liquid being pumped to obtain bhp when handling that liquid
Read 67 total head
System curve for 30 gpm
Gpm
Bhp
Read 1.5 x 1.2 = 1.8 bhp
Total head in feet
Efficiency, percent
Brake horsepower
Gpm

**Fig. 2—When the two 30-gpm pumps operated in parallel, the brine flow did not reach 60 gpm because the total dynamic head increased to 135 ft. This required larger pumps**

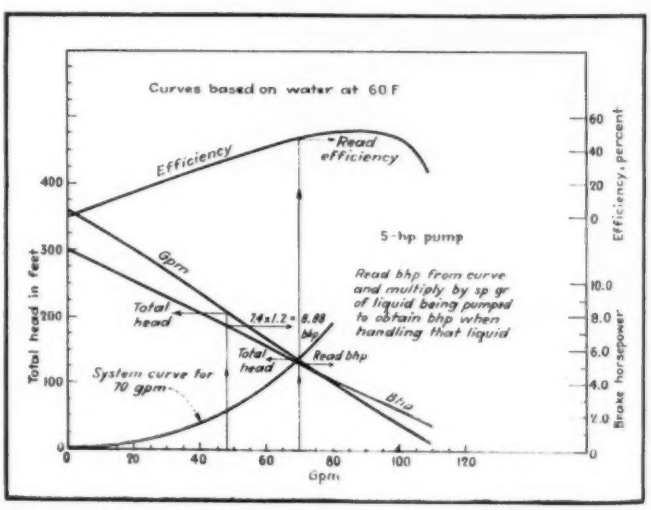



**Fig. 3—This characteristic curve of the 5-hp pump shows that a flow rate of 48 gpm requires 8.88 hp. To prevent overheating of the motor, the pump discharge was throttled**

# Refrigerating a 29.3-Inch Vacuum At −130 F Uses 35 Horsepower per Ton—

***But it provides fast refrigeration to calibrate weather instruments that travel into the stratosphere and transmit data to receiving stations. Differing from the conventional systems the plant has to provide pressure and temperature variations***

▶ A FREON-22 SYSTEM using a 7¾x5-in. booster and 4x4-in. second-stage compressor refrigerates the low-temperature chamber in which radiosondes (radiometeorographs) are calibrated. Although refrigerating load is under ½ ton, machine drive totals 17.5 hp to produce quick results.

An instrument such as the radiosonde, which goes up into the stratosphere, encounters such extreme weather conditions that no dependence can be placed on its operation unless it is tested and calibrated under similar conditions. The radiosonde is carried aloft by a balloon until the latter bursts after which the device descends by parachute. During the trip it transmits radio signals indicating temperature, humidity and air pressure of the areas through which it passes. The signals are picked up by receivers and recorded to make a permanent record of air conditions.

To assure accuracy instruments at the Friez Instrument Div, Bendix Aviation Corp, are calibrated in a test chamber that simulates actual flight conditions—rate of temperature and pressure change is similar to that encountered by the instrument while in flight. Test chamber is a jacketed cylinder mounted horizontally in a box structure packed with insulation. A door in one end contains an 8-pane window giving full view of the interior. Door is initially tightened with jack screws but after the chamber is evacuated there is a force of about 4.5 tons holding it closed.

### *Internal Construction*

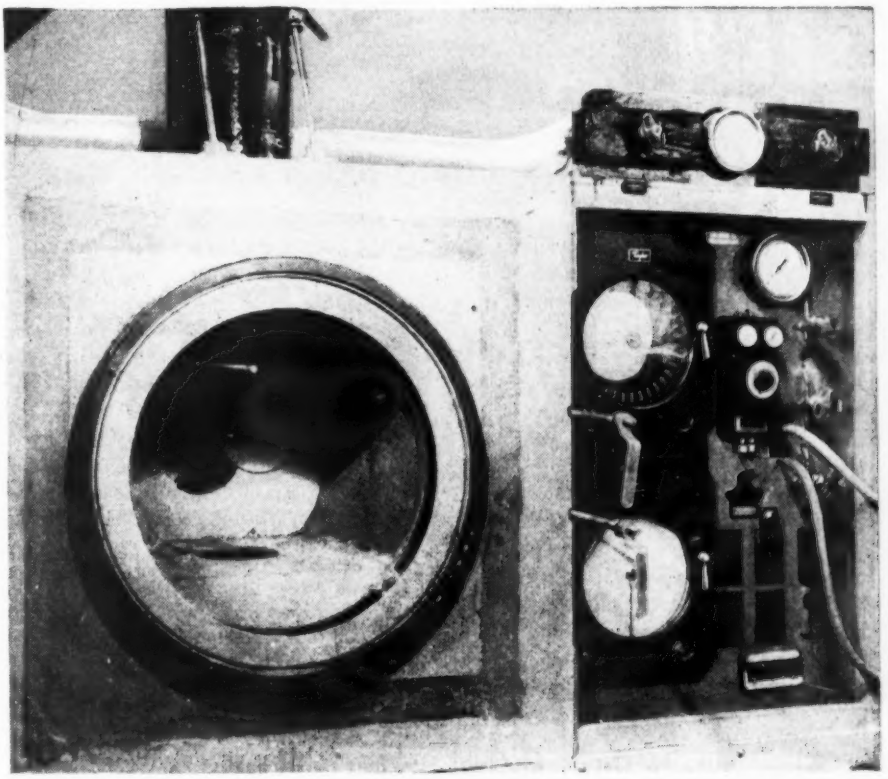
Against the cylinder inner wall is a layer of refrigerant coils fed by a liquid header at the top. Suction comes off the bottom. Inside the coil is a metal cylinder with its rear end closed and fitted with a damper operated from the outside. Lower side of cylinder containing an air-flow opening forms a shelf to hold the instruments, which are placed over the hole.

A fan, whose shaft extends through a rotary seal to the outside driving motor, induces air circulation through dampered hole in rear of cylinder and down over the instrument. Fan discharges to rear of cabinet through an electric heater and then across the refrigerating coils. Heat is added when necessary to balance the cooling load and obtain the desired temperature. Damper adjustment varies the air velocity across the instrument, and a mercury column beside the chamber measures the pressure inside.

Although test program is to lower the air pressure inside the chamber as its temperature drops, for special purposes the inside atmosphere can be maintained at any temperature and vacuum. At the start, chamber temperature is lowered to −67 F in 75 min while the vacuum is raised to 23 in. of mercury. In another 45 min the temperature reaches −100 F and the vacuum 26 in., initially and finally 29.3 in. at −130 F when required. Last phase of test is to break the vacuum and heat the chamber to ambient temperature or above.

Once the chamber is cooled the refrigerating load is so small that suction gas returns in a highly superheated condition. Early tests after installation but before insulation was applied showed frost accumulation on the suction line during preliminary pull down. When temperature reached −80 F the frost disappeared, and as the temperature continued to drop the line warmed up to room temperature.

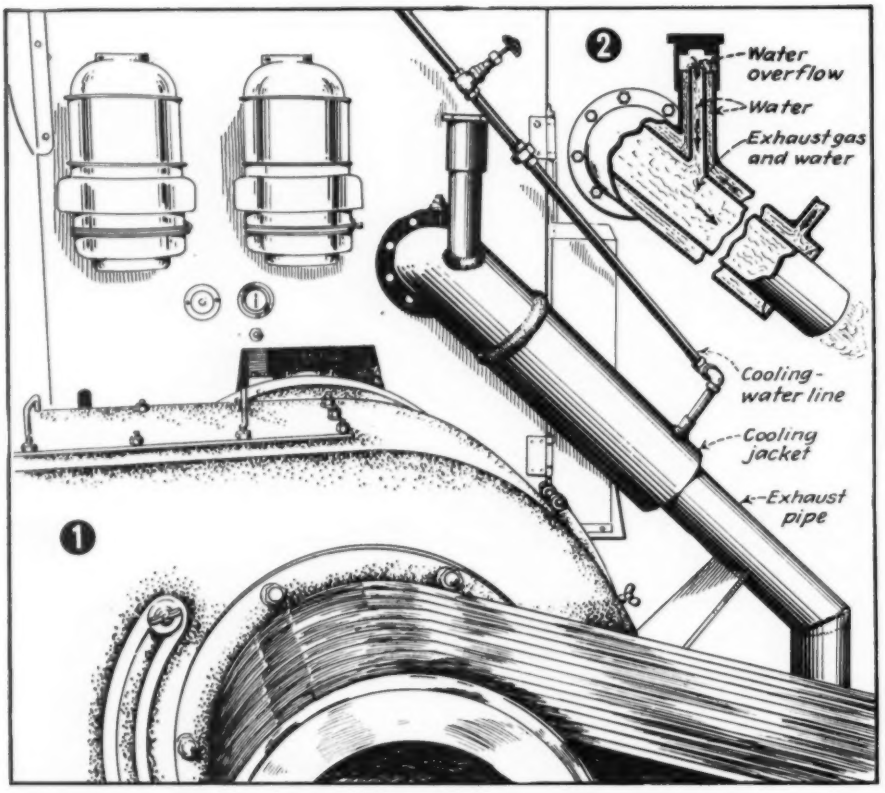
Another interesting phenomenon is the action inside the cylinder. At a vacuum of 23 to 26 in., cooling rate is considerably slowed down. The high vacuum prevents active heat transfer and only a small quantity of air (by weight) circulates.



**One hole in rear, another in the shelf direct circulated air down over instrument. Refrigerating coils are between the two shells.** *Courtesy of Friez Instrument Div*

*Plant-Tested Methods and Ideas for Power Men*

# PRACTICAL Aids to Operation




## COOLING WATER QUENCHES EXHAUST GAS

ONE COMPANY DEVELOPED an ingenious but simple method to keep internal-combustion-engine exhaust-gas temperature below a value that would ignite inflammable gases and liquids. This method cools the exhaust line with water, which afterwards enters the line and is discharged with the gas to do additional cooling.

Automatic in operation the cooling system includes a water jacket welded around a 5-ft section of the exhaust line close to the engine, as in Fig. 1. The jacket is of a diameter to form a 1- or 1½-in. annulus between jacket and exhaust pipe. To complete the circulation system, cut a ½-in. hole in the exhaust line's top near the upper end of the jacket.

Centering around this hole cut a 1½-in. hole in the jacket. In the exhaust-pipe hole weld a ½-in. nipple 6 in. long; in the jacket's hole weld 1½-in. nipple about 4 in. long with a coupling on its end. A cap screw is screwed in the coupling to close the cooling system. Fig. 2 shows a cross-section through this part of the cooling system. Near the lower end of the jacket cut a hole for a ¼-in. nipple and weld one in, as in Fig. 1. Connect this nipple through a valve to the cooling-water supply.

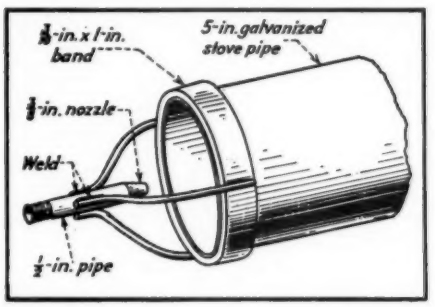
Before starting the engine remove the cap from the overflow and open the valve to fill the water jacket. After filling the jacket to overflow, pinch down the valve until there is a small overflow into the exhaust line. Replace the overflow-connection cap and start the engine. Its exhaust gas will be cooled by coming in contact with the exhaust pipe and by evaporating the water that overflows into this pipe. By the time the gas discharges to atmosphere it is well saturated with water vapor and any incandescent particles of carbon are extinguished.

*Pomona, Calif.* G M WILSON

## This Bazooka Never Went to War

THE DIAGRAM SHOWS A DEVICE that we christened a bazooka. It was primarily built to cool and ventilate tanks and heaters but we have used it for many other purposes.

The bazooka is made of three lengths of 5-in. galvanized stove pipe, tack-brazed together, and reinforced at one end with a $\frac{3}{16}$ x 1-in. steel band brazed to the pipe. We made the air nozzle from a piece of ½-in. extra heavy pipe forged down at one end to a $\frac{3}{8}$-in. opening and threaded at the other end for a compressed-air connection. Three pieces of $\frac{3}{8}$-in. round steel, bent and welded as shown, support the air




nozzle ½ in. away from one end of the pipe.

This device has many uses around the power plant. It cools overloaded motors and switches temporarily; circulates air for men working in hot places; clears contaminated air from tanks or boiler drums, or smoke and fumes from welding operations. We have used it to cool the inside of hot storage tanks, by sticking its free end through the manhole at an angle of about 30 deg and blowing with a full blast of compressed air. In 15 min. men could work inside the tank, whereas six hours are needed to cool it by natural means.

The air nozzle connects to the com-

pressed-air supply by a hose with a control valve between hose and nozzle. The bazooka is light and easy to handle and can be operated on compressed air at pressures of 10 to 150 psi. By throttling, the air supply can deliver a gentle breeze or a hurricane's blast as required by the job being done.

*South Amboy, N. J.* RAY SEPTOR

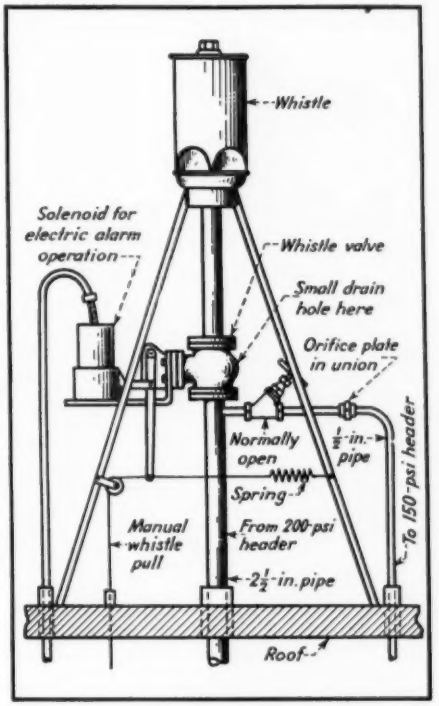
## Keeps Dry Steam At Alarm Whistle

WHEN A STEAM WHISTLE is also used as a fire alarm, live steam should be maintained at the whistle valve at all times. The usual slugs of condensate found in many whistle steam lines are not conducive to short snappy signals especially when saturated steam is used in a long line. The following system developed in one plant insures dry steam at the whistle.

The new boilers operate at 200 psi and the older ones at 150, with a reducing valve between their headers. The 200-psi header supplies the whistle. It is above the roof, and is arranged to be blown electrically from the fire-alarm system, or manually.

Just below the whistle valve a ½-in. bypass line connects to the 150-psi header, as shown. To limit steam flow to the 150-psi header an orifice disk with a $\frac{3}{16}$-in. hole in its center is placed in a union in the bypass. The 50-psi difference between the two headers maintains sufficient flow in the whistle pipe to keep the steam in it always hot and dry. As an added precaution a small drain hole was drilled on the outlet side of the whistle valve. In case of a small leak through the valve the resulting condensate will drain out of the line between valve and whistle. This system can be used in any plant operating with two different steam pressures.

DEAN H BERGMAN
*Bellingham, Wash.*

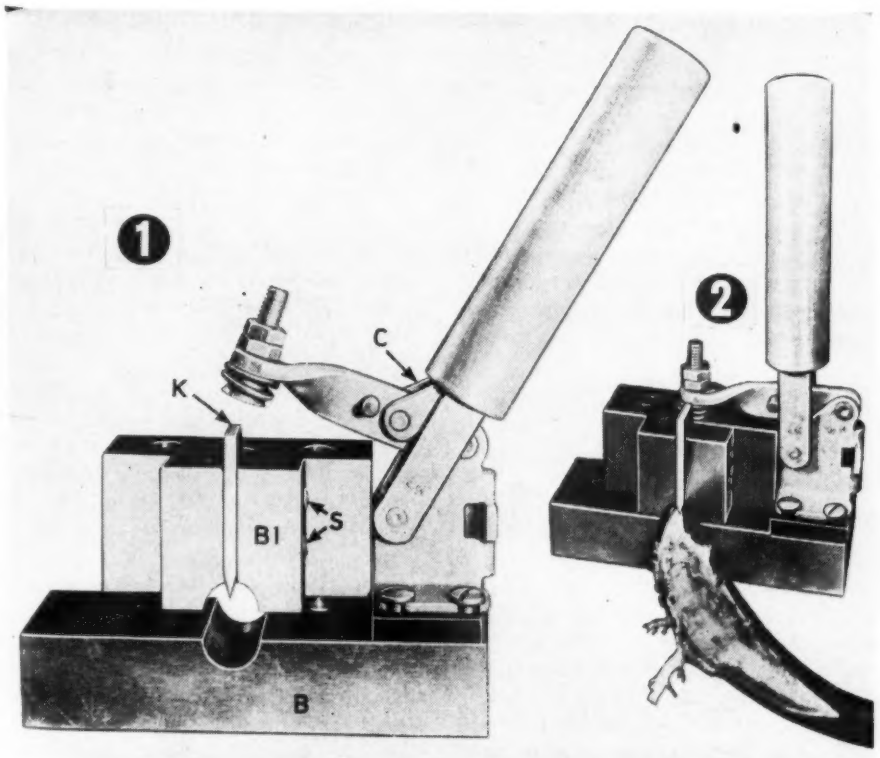



## SIMPLE TOOL STRIPS CABLE INSULATION

THE TOOL IN FIG. 1 strips insulation from heavy cable. Toggle clamp *C* fastens to block *B*, which serves as the tool's base. An adjustable knife *K* is positioned in an upper block *B*1 and held by two set screws *S*. Block *B*1 is positioned on base *B* by two pins. The base is counterbored around the two pin holes for springs that raise block *B*1 when toggle *C* is released, as shown.

Semicircular recesses in the base and block provide a circular guide for the cable under the knife. When the toggle arm is thrown to the right it releases the block, which is raised by the two springs between it and the base, as in Fig. 1. The cable can then be positioned in the circular groove and the knife clamped on it by moving the toggle arm to the left, Fig. 2. Then the cable is pulled through the tool by hand, which slits the insulation with little effort. The simple design makes it easy to build the tool in any shop.

*Baltimore, Md.* A H LANGLOIS
*Westinghouse Electric Corp*




## Preparing Cast-Iron Boilers For Inspection

SAFETY IN OPERATION may prevent costly accidents, while efficiency in operation usually means money saved for the fuel buyer and more desirable working conditions for all concerned. The following maintenance suggestions apply to cast-iron steam heating boilers. A hydrostatic test is normally applied during the summer, and to facilitate inspection the suggested procedure should receive prompt attention at the end of each heating season.

1. Drain and refill the boiler with water. Unlike steel, cast-iron boiler sections are not readily attacked by internal corrosion. Keep water at normal operating level in the boiler during idle periods to prevent deposits from drying in accessible parts.

2. Clean the furnace and fire surfaces. Remove all ash, soot and refuse, and brush surfaces clean. If boiler surfaces are not clean, a defect may be hidden un-

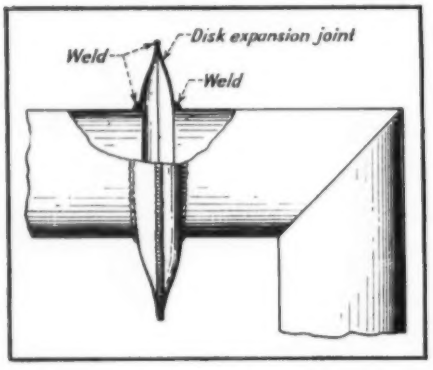
til boiler is needed badly during the next heating season. A general housecleaning at the end of the heating season is usually necessary. For a start, clean out the ashpit, brush off boiler's outside, replace the gageglass if stained, replace burned or broken grate bars, and brush off and paint any parts starting to rust. Burning rubbish in the boiler during summer months is bad practice.

3. Make sure all valves are in good operating condition. Try all valves on steam lines, return piping, feedwater and blowdown lines, and on gageglass connections. They should operate easily and seat tightly, but if they don't, repacking, lubricating and general overhaul are usually necessary.

4. Check feedwater flow. Flow of water to the boiler must be adequate. If flow is sluggish, it may indicate an obstruction in feed pipe. Clear or renew any obstructed pipes.

5. Inspection of boilers operated all year. Apply a hydrostatic test at least once each year. A hot boiler may be damaged by filling with cold water; therefore arrange to cool boiler before making test. Plan operations to permit boiler to remain out of service for one day for maintenance according to this program. When properly prepared for inspection a boiler is clean, cool and dry.

*Canton, Mass.* HARRY M SPRING

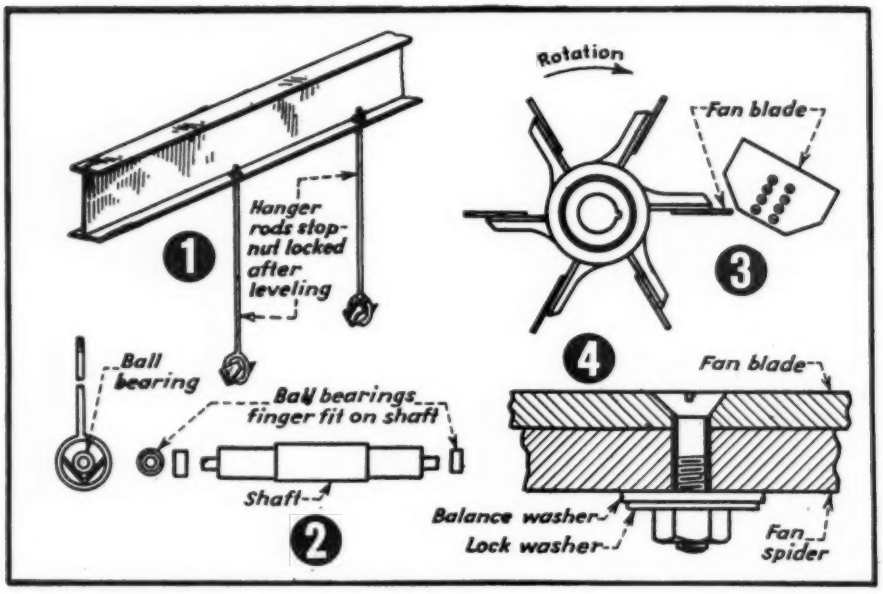



## Disk Expansion Joint Serves in Close Quarters

A LARGE DIESEL ENGINE was installed in a building near a highway. The exhaust line had to be carried under the highway, which is so close to the plant that the line makes a 90-deg downward turn near the engine. To absorb expansion and contraction stresses in the line an expansion joint had to fit in a 4-in. space.

This problem was solved with two light steel disks, 18 in. in diameter. These were disked and in the center of each a hole was cut of a diameter equal to that of the exhaust line. The disks, with their concave sides facing, were fitted over the cut-apart exhaust-line ends and their outer edges welded together. Then the disks were welded to the line to form the arrangement in the figure. This joint has given excellent service and provides sufficient expansion for all changes of temperature without any evidence of cracking in the joints.

*Pomona, Calif.* G. W. WILSON




## BALANCES FAN ROTOR AFTER REBLADING

BALANCING an overhung fan rotor in place on its motor shaft is a tedious and often unsatisfactory job. For the three ball-mill coal-pulverizer exhaust fans in our plant we maintain a spare rotor with new blades that has been balanced on a dummy shaft. As shown in Fig. 2, this shaft has ball bearings in each end and is hung by a comparatively long rod to an overhead I-beam in our shop, Fig. 1.

At the free ends of these rods are rings with a vee welded to their inside, on which the dummy-shaft ball bearings rest. The shaft at its center is made to have a light-drive fit in the fan's rotors. After a rotor has been rebladed or repaired it is mounted on the dummy shaft and supported on the ball bearings in the rings at the end of the balancing rods.

The antifriction bearings make it easy to check the rotor's unbalance. When the light side is located, balance washers are added to it until the rotor remains in any position to which it is turned on the bearings. Fig. 3 indicates the general construction of the rotor while Fig. 4 shows how the balance washers are placed on the bolts holding the fan blades to the rotor-spider arms.

*Duluth, Minn.* GEORGE I SMITH

## Requirements for Safety-Valve Setting

ALTHOUGH THE INFORMATION presented here is readily available it is surprising how frequently even experts lack these facts. According to ASME Code for Power Boilers and codes of many states, every boiler requires at least one safety valve. If a boiler has more than 500 sq ft of water-heating surface, or generates more than 2000 lb of steam per hour, it needs two or more safety valves.

It is generally required that safety-valve capacity be sufficient to discharge all steam that the boiler can generate without the pressure rising more than 6% above the highest pressure at which any valve is set, or more than 6% above maximum allowable working pressure. Multiple safety valves may be set so that the pressure-setting range of all saturated-steam safety valves shall not exceed 10% of highest pressure to which any valve is set. Ordinarily one or more safety valves are set at or below maximum allowable working pressure, with one valve permitted a pressure setting not higher than 3% above maximum allowable working pressure.

In many installations advantage is taken of the allowable pressure-setting range, with one valve or pilot valve set as much as 15 lb or more below the

main valves. This practice is followed to give the operator warning that excessive pressure is being approached so he can take steps to prevent loss of as much steam as possible. Setting of valves to blow in steps removes some of the burden that would be imposed on a control system if all safety valves blew at once and created an excessive steam demand instantaneously.

*Cincinnati, Ohio* WILLIAM J BURNS

## How to Correct Wrong Polarity

OLDER DESIGNS, of dc generators particularly, sometimes lose the residual magnetism in their field poles and fail to build up voltage when they are brought up to speed. When operated in parallel, shunt generators are most likely to develop this trouble that seldom occurs on compound wound machines.

On the latter, excitation of the series-field winding, from other machines when the equalizer is closed, is sufficient to provide an initial voltage in the armature winding. This voltage applied to the shunt-field winding builds up the machine with the correct polarity. Load on the machines in service and the resultant current in their series windings determine initial excitation of the incoming machine.

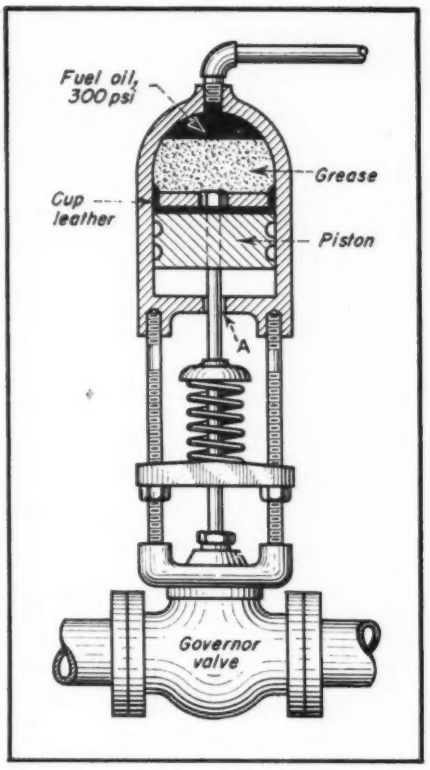
On shunt generators accidental field-pole-polarity reversal can be corrected by exciting the field coils from an outside source. Simplest way of doing this is to put sheet insulation between the brushes and commutator, sheets of thin fiber being suitable. Be sure that the brushes are insulated from the commutator so as not to cause a short circuit when the field coils are energized by closing the generator switch to the busbars.

If this switch is made up of single-pole units, close one of the switches and connect a lamp bank across the other. Then, in case the brushes have not been properly insulated a short circuit will not develop. To prevent induction of excessive voltage in the field coils be sure that all of the field-rheostat resistance is cut in series with the field coils before opening the excitation circuit.

*Bolton, England* W M GORE

## Stops Oil Leaks In Pump Governor

OUR FUEL-OIL PUMP control has a piston-top governor, as in the diagram. A cup leather on the piston's top and two circumferential grooves prevent oil leaking by the piston. After a few weeks' operation the cup leather hardened and let oil leak by the piston and out around the valve stem at *A*.




To correct the trouble we filled the cylinder above the piston with heavy grease as shown. After five months of continuous operation the fuel oil at 300 psi has not forced the grease past this piston. A simple remedy has cured our trouble.

*Flushing, N. Y.* S M ELONKA

## Cures Oil-Reservoir Condensation Troubles

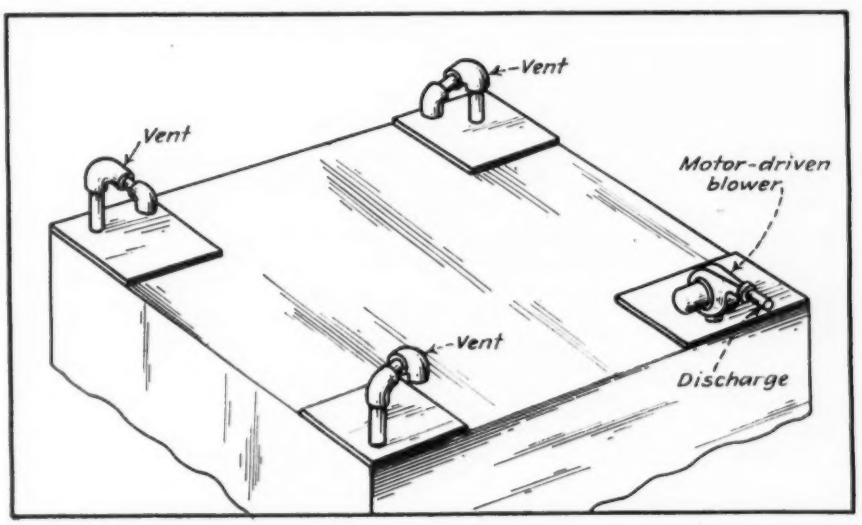
WE HAD TROUBLE with condensation, which formed in our turbine-oil reservoir, got in the oil and caused it to emulsify. To correct this condition an oil-company engineer recommended installing a 1-in. vent in three corners of the reservoir cover and a 2-in. one with an exhaust fan in the fourth corner. This we did as in the figure. We removed the reservoir's cover inspection plates, drilled and tapped them for the vent connections. To maintain air circulation through the reservoir above the oil we installed a squirrel-cage fan with a 3-in. suction and 2-in. discharge, as shown.

When we removed the reservoir's cover inspection plates we found the inside of the plates and the reservoir covered with rust globules filled with water. They were about ½ in. long; each corner of the reservoir was filled with emulsified oil and rust.

We removed the oil and thoroughly cleaned the reservoir, filtered and replaced the oil, and put the turbine back in service. Since then, with the ventilation system in operation, we have not found the slightest trace of moisture in the reservoir. The oil-reservoir gage glass remains free of moisture whereas, before installation of the ventilation system, large drops of water formed in it.

We could not get the small blower when the rest of the equipment was ready for service. Therefore, for a while we operated with a 10-in. fan, located back of the 2-in. elbow and blowing by its open end. The air currents by the elbow produced sufficient ejector effect to cause a mild air circulation through the oil reservoir to remove the moisture until the blower was installed. Very little oil vapor comes out with the air and what does condenses and drips from the fan discharge into a pan. Install the air vents close to the reservoir's corners as these are the most troublesome spots.

*Tulsa, Okla.* WARNER M BYARS



# READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

## 1—What Causes These Boiler Tubes to Erode?

DURING THE PAST YEAR one of our boilers has had three tube failures. They are not caused by overheating or scale, as we supposed, but result from some external abrasive action that eats holes in the tubes from the fireside.

The boiler giving trouble is a 554-hp unit with superheaters, and is fired by a chain-grate stoker. It is equipped with soot blowers. The damaged spots look as though the action of the jets causes the erosion, but we are not sure. Air is used in the blowers.

While the boiler has been in use about 20 years it has had good care. It supplies steam to a turbine, and the load has been rather constant. The tubes are well slagged, which makes it difficult to get them out.

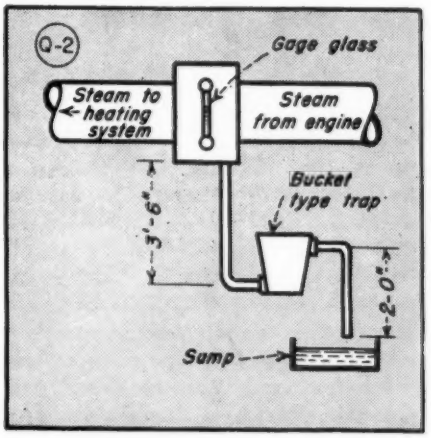
It seems to me that the tubes should have lasted much longer. I would like to hear from other engineers who are POWER readers. Can they tell me the cause of the erosion and suggest some remedies to protect the tubes—*CAM*

## 2—Why Doesn't Trap Work All the Time?

THE HEATING SYSTEM in our building uses exhaust steam from a reciprocating engine. Near the engine in the exhaust line is an oil separator, which drains to the sump through a bucket trap, as in Sketch Q-2. Pressure in the exhaust or heating line varies from 20 to 12 psia.

Recently when we were working on the heating system, we found it full of cylinder oil. We immediately checked the operation of the oil separator, but it would not drain through the trap when the heating system was operating on a vacuum. Our next step was to check the trap. It was in good working condition—a fact that was borne out by its performance when the heating system was operating on pressure above atmospheric.

I cannot see why the difference in pressure should affect the operation of the trap, but it does. Can POWER readers tell me why the trap refuses to function when the system is operating at a vacuum and how to correct my difficulty?—*EEL*

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## What Refrigeration Controls Are the Best?

*(This is Question 1 from the March issue, with best answers from readers)*

I WOULD LIKE TO KNOW *how many different arrangements of temperature, pressure and level control can be used on the following general refrigeration systems: (1) single installation of a flooded or dry evaporator and one condensing unit (2) multiple installation of two or more evaporators, operating either dry or flooded, and connected to one condensing unit (3) multi-temperature system consisting of two or more evaporators each operating at a different temperature, either flooded or dry, and all connected to a single condensing unit in the system.*

*I realize this involves many varieties of control systems, but I would like to know what the best type is for each system. Will* POWER *readers describe control systems they have used and show how they were connected?—LRT*

## Controls for Single Evaporator and Condenser

A GOOD CONTROL SYSTEM for the first part of *LRT's* problem is shown in sketch 1-*A*. In this system the h-p cutout stops the compressor when head pressure reaches some predetermined value, say 175 lb, and allows it to restart after pressure has dropped below 165 lb. Low-pressure control unit stops compressor at 25 lb and restarts it at 38 lb.

The solenoid valve opens only when compressor or thermostatic control, or both, calls for more refrigeration. Thermostatic control—located in medium to be cooled—is set for desired temperature or temperature differential, and starts and stops the compressor.

Expansion valve ahead of dry evaporator regulates the flow of refrigerant, and can be either hand or automatic.

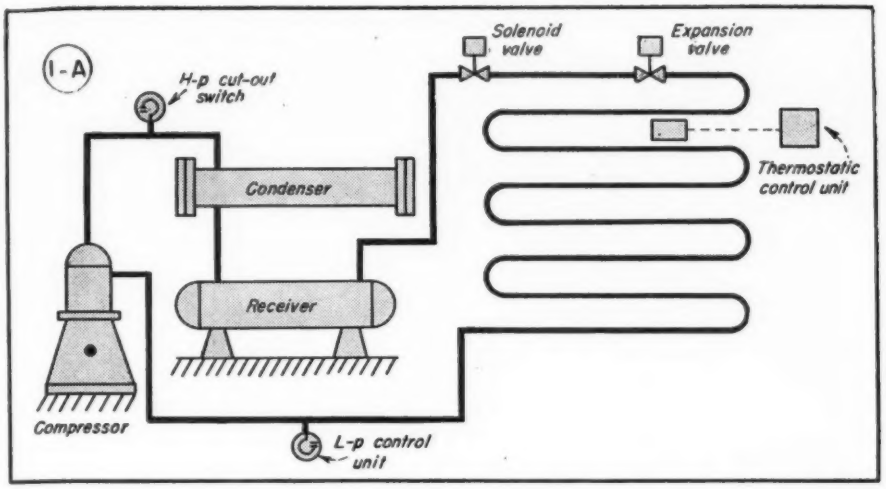
*Brooklyn, N. Y.* A J WENIG

## Refrigeration Controls That Do a Good Job

IN SYSTEM (1) of *LRT's* question, the following methods work best:

1. For self-contained sealed units, a capillary tube for liquid control and a thermostat for motor control, sketch 1-*B*, *a*, form the most popular combination for regulation since the method costs less than any other and the motor starts under no load. This control works well with most condensing units, but the system has no reserve refrigerant. The evaporator operates flooded, but should be designed for dry operation to insure oil returning to compressor. Pressure control of motor cannot be used with this system as high- and low-side pressures equalize during the off cycle.

2. Thermostatic-expansion valve for liquid control, with thermostatic control of motor on remote installations, is one of the best regulating methods. A liquid receiver is used on the high-pressure side, as in *b*, for excess refrigerant during normal operation. Evaporator operates flooded but can be a dry type.




3. Automatic-expansion valve for liquid control, with thermostatic control for motor, has one advantage: Motor operates at constant load from point of view of backpressure or suction. Evaporator operates dry as in *c*.

4. Low-side float for liquid control, in *d*, with thermostatic or pressure control for motor, operates like thermostatic-expansion valve for liquid control, 2 above, except it is not so flexible, and the system requires more refrigerant. The evaporator operates flooded.

5. High-side float for liquid control, with thermostatic or pressure control of the motor, allows most of the liquid refrigerant to pass to the low-pressure side of the system as in *e*. The float tank can also be used as a liquid receiver. Evaporator operates flooded.

For *LRT's* system (2), a thermostatic-expansion valve for liquid control with pressure control for motor, sketch *f*, is the best for a remote multiple installation. The low-side float for liquid control can be used, but it is not so good.

For *LRT's* system (3), the multiple installation can be applied in two ways. This type of installation, however, should be avoided except for following cases:

1. If the higher-temperature loads are light as compared to the low-temperature load, it saves some investment cost without lowering efficiency too much. The regulation is the same as for any multiple installation except that a valve to regulate backpressure or differential pressure is installed in the suction line of the warmer evaporators, sketch *g*.

2. If it is desirable to operate two or more adjacent evaporators at different temperatures they can be connected in series with a high-side float feeding the warmer evaporator, as in *h*, and with a pressure-regulating valve connected between the evaporators.

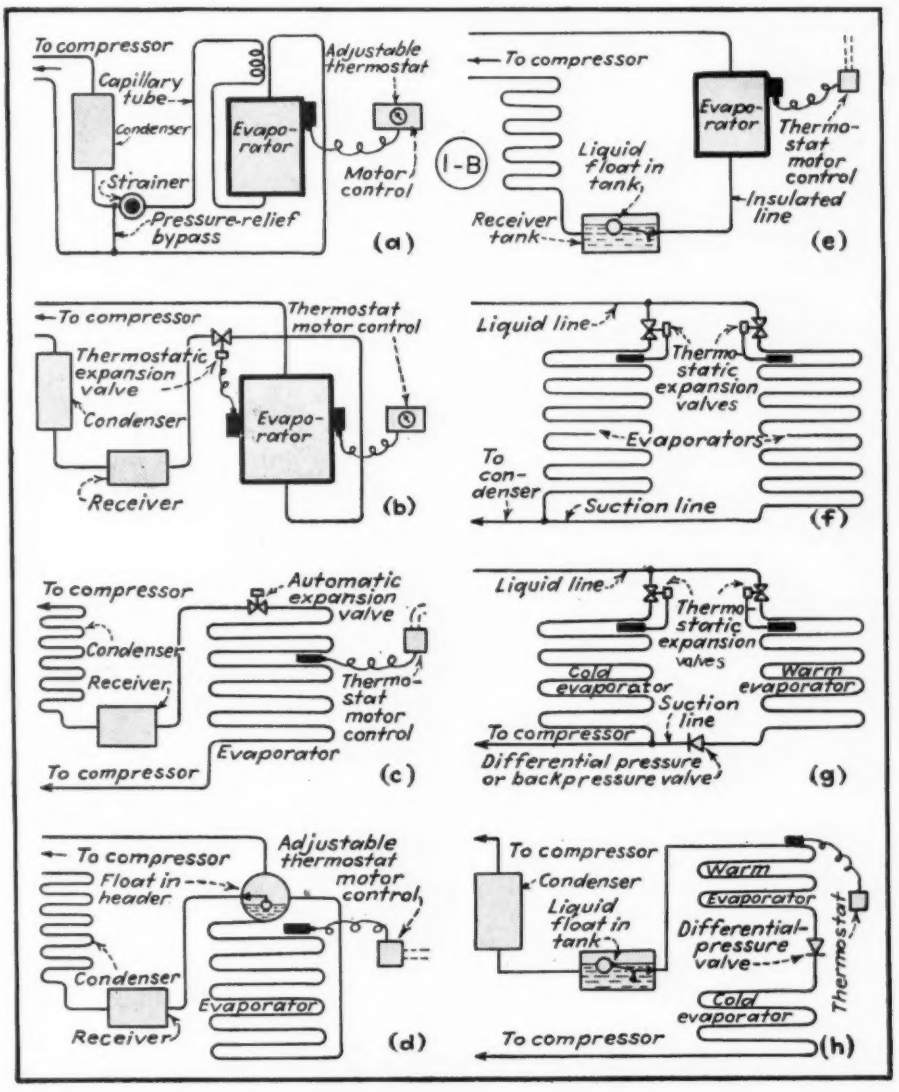
*Pueblo, Colo.* C L CARTER

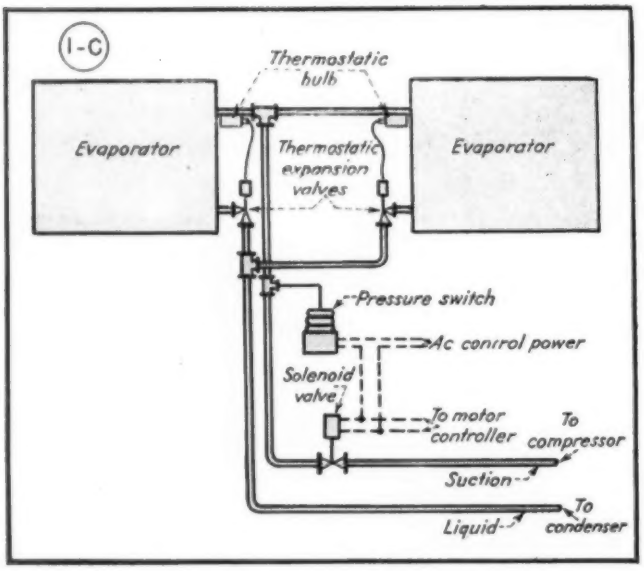
## Evaporators With the Same And Different Pressures

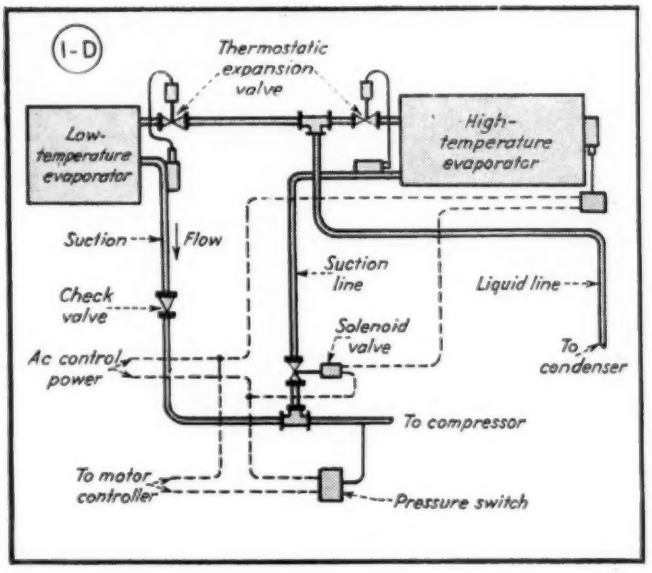
FOR SYSTEM (2) of *LRT's* question there are several installations in which evaporators may operate at the same or nearly the same temperatures. Temperature control is by a single solenoid valve in the suction line coming from both evaporators, as in sketch 1-*C*. The solenoid is actuated by a pressure switch in the line from the two evaporators. Since the same suction pressure or evaporating pressure thus controls both evaporators they will operate at the same temperature. To enable them to carry different loads and keep fully refrigerated at the same time, each is equipped with a thermostatic-expansion valve.

The two single-temperature evaporators are shown connected to a common suction and liquid line.

For *LRT's* system (3) the method of obtaining two different refrigerating temperatures with two separate evaporators is shown in sketch 1-*D*. Refrigerant control is a thermostatic expansion valve for each evaporator. The cycling control for the compressor is a low-pressure switch. The refrigeration and cycling control together use a solenoid valve in the suction line from the high-temperature evaporator and a thermostatic






switch for opening and closing the valve. Check valve in the suction line from the low-temperature evaporator is a small spring-loaded valve. It permits free flow of vapor from low-temperature evaporator to compressor through the suction line but automatically closes should there be a tendency for vapor to flow towards the evaporator.

*Oaklyn, N. J.* C A WILKES

## How Can I Correct This Engine Governor?

*(This is Question 2 from the March issue, with best answers from readers)*

A SECONDHAND 2-CYLINDER *uniflow steam engine, direct-connected to a 300-kw ac generator, supplies some of the power in our building. The generator is synchronized with the local power system because average load consists of 465 kw of which 300 kw is supplied by the engine and the remainder by the power company. For normal operation we adjust the load on the engine by compressing a spring with the synchronizing motor on the engine governor. The engine load has always been selected and adjusted manually. On a few occasions recently our load has dropped off. Every time it goes below 300 kw reverse power relays open the circuit to the utility system and our engine overspeeds and trips off.*

*I have never heard of this happening on other engines operated like ours. I believe there is some defect in the governor that keeps it from regulating the speed on loads below selected values. The governor is a simple flyball type mechanically connected to the engine valve-mechanism. The only adjustment I can find is the motor-operated spring for synchronizing and adjusting the load.*

*I would like to know whether* POWER *readers have experienced similar conditions and how to correct the trouble without buying a new governor?—JAE*

### Check Operation by Watching Wattmeter

THE TROUBLE IS OBVIOUS, although the cure is not so easy. Opening of reverse-current relays indicates that power is feeding back into the utility system. This is confirmed because his engine races when the relay is open as a result of removing some of the load.

The only solution that comes to my mind is to watch the wattmeter and take the load off engine manually before it begins to feed back into the utility line. Possibly by watching the action of the governor, another solution can be found.

The average commercial governor is not very sensitive to slow speed changes, and engine speed can increase very slowly to a point somewhat above normal without actuating the valve mechanism. As mentioned above, a governor of this type makes hand operation essential.

*Carlsbad, N. M.* E A ROBERTS

### Make This 4-Point Governor Inspection

THERE ARE FOUR major factors to be considered on *JAE's* engine before restoring it to good working order:

(1) Some flyball governors are equipped with dashpots. If his governor is so equipped, the dashpot should be removed for inspection.

After removing the dashpot *JAE* should completely dismantle and wash all parts in kerosene. He should inspect the bypass, which controls the oil-flow rate from one side of the piston to the other. This is important as it is the regulating factor. After dashpot has been cleaned and filled with a light oil adjust it so engine operates without hunting. Several adjustments may be necessary before the control is satisfactory.

(2) Set the overspeed governor by putting the unit on the line, synchronized with the power systems, and check the speed with a tachometer. This establishes normal full-load speed. Open the generator switch and increase speed to the desired tripping point, usually 10 or 12% above normal, and adjust the overspeed governor to trip at this speed.

(3) Try all the linkages for lost motion from the point where they control the valves to the flyballs. This must be small, and where good regulation is required it should be 0.010 to 0.015 in. maximum. Worn pins, shafts and bearings must be restored to new condition. Check the thrust collar and any other sliding fit for shoulders or imperfections that could retard free governor movement.

Mark adjustment of spring. Remove it and test the mechanism for free and unrestricted movement by slowly moving the weights through their entire range. Any perceptible binding in the mechanism must be eliminated.

If overspeeding continues, it is caused by serious leakage in the inlet valves, or the governor cannot shorten the cutoff enough to control speed at no load.

(4) When engine trouble develops, indicator cards are always in order. Take a series on both cylinders from no load to full load. Reason for this can

best be visualized by referring to indicator diagrams, sketches 2-*A* and *B*. These were taken from a secondhand uniflow engine, where serious overspeeding developed. Diagrams *a* to *e*, 2-A, were taken before any adjustments were made.

The unit is a 14x16-in. horizontal uniflow engine with poppet valves and an inertia-type governor. The engine is direct connected to a 100-kw 60-cycle 3-phase 277-rpm generator; boiler pressure is 150 psig.

Diagram *a*, sketch 2-*A*, was taken with 50-kw load. Diagrams *b* to *e* were taken at no load, with full voltage on generator, at 2-min intervals. No adjustments were made between cards. Speed taken with a tachometer varied from 300 to 352 rpm. The work being done shifted back and forth from one end of the cylinder to the other intermittently. This showed valves were sticking when open; therefore they were dismantled and cleaned. Valves were set by measurement, and final adjustment made according to indicator cards.

Governor was blocked in full-speed no-load position. The no-load valve lift was set at 0.009 in. with the dial indicator. Diagrams *a* and *b*, sketch 2-*B*, were taken. The governor was blocked in full-load position for card *b* and measurements rechecked. An offset key was placed in the flywheel that advanced it one degree; valve settings were rechecked on both no-load and full-load positions. Final results are shown in diagrams *c* and *d*. The unit gave no trouble during the next three years.

*Buffalo, N. Y.* S C PAGE

## Governor Wear Is Cause of Trouble

I BELIEVE THE TROUBLE is in the governor, as *JAE* mentions. If the engine load has always been selected and adjusted manually and given no trouble until recently, wear of governor parts would be the logical cause of trouble.

When a governor is properly set, it controls speed regardless of how many times load fluctuates. Difference between engine output and local power system should have no effect on it. If the load gets smaller than the engine output then the reverse-current relays operate and the engine speeds up for two reasons: (1) Light load causes the engine to race until it reaches its proper operating speed. (2) If the governor is worn by average travel and a shoulder on a moving part is worn, spring tension is not enough to regulate speed before engine trips off.

*Philadelphia, Pa.* W T MULLEN

## Too Much Friction In Linkage Mechanism

I BELIEVE friction somewhere in the governor mechanism causes the engine to overspeed and trip out when the load drops below 300 kw.

If the exciter is driven by a motor which is connected to the utility line this will cause the trouble. The exciter motor shuts down when the reverse power relay operates; therefore the engine generator loses its field and consequently loses its load. With loss of load, the engine naturally overspeeds and trips out.

*Beverly, Mass.* R B GOLDSMITH

## Isochronous Governor Will Correct Trouble

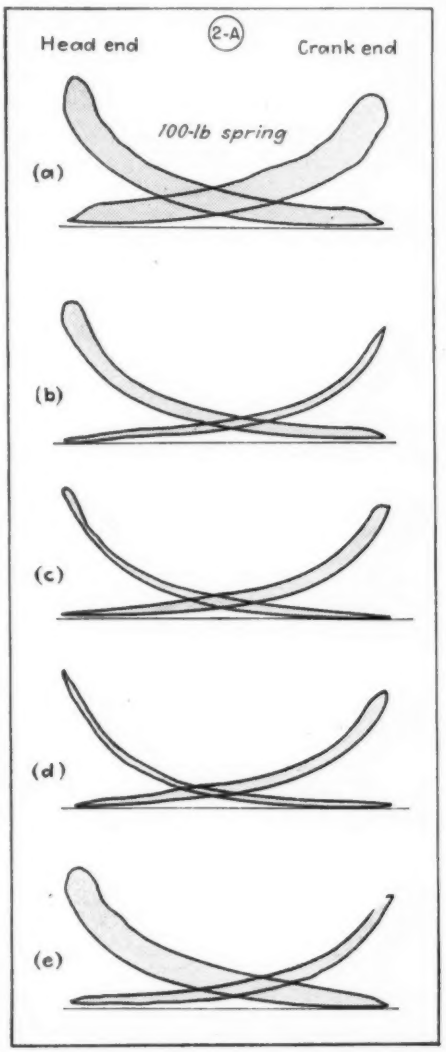
FROM *JAE's* DESCRIPTION of his steam engine the trouble appears to be a combination of inadequate governing and defective control linkage.

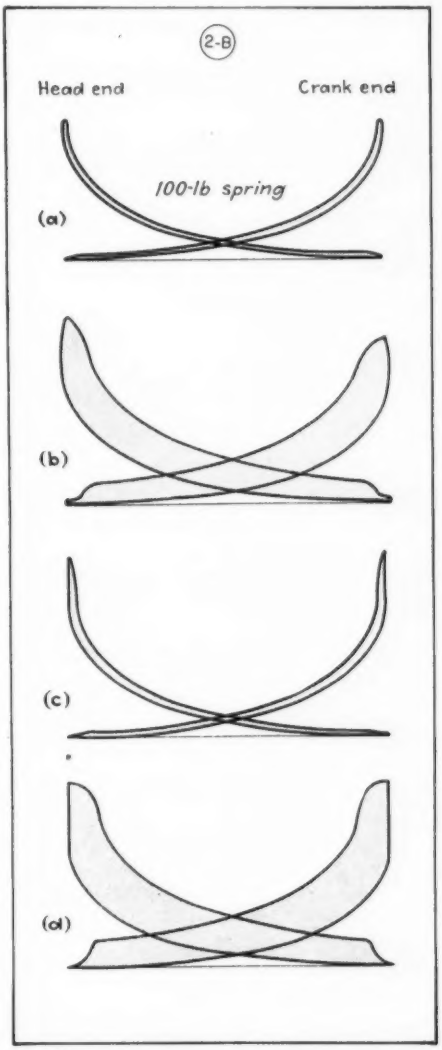
The simple flyball governor without provision for adjustment of spring tension with changing load is not a constant-speed governor. Conventional synchronizing motors provide adjustment of governor spring tension to permit (1) manual adjustment of engine speed for synchronizing with other generators and (2) manual positioning of the governor for any desired load.

After *JAE's* generator is paralleled with the utility system and load adjusted manually to 300 kw, here is what happens when the building load drops to 250 kw. Engine governor does not function because there is nothing to cause a change in engine speed. Consequently, the generator continues to deliver 300 kw, 250 of which goes to supply the building load, the remaining 50 being fed back into the utility system. This reverse flow of load to the utility system actuates the reverse-current relays which trip the circuit breaker.

For the first time the governor is called upon to function because dropping 50-kw of load causes the engine to speed up. Some increase in engine speed is

(*Continued on page* 164)



# WATER-TREATMENT QUESTION BOX

## WHY SCALE ON BOILER SURFACES?

By K M Herstein and John S G Shotwell

▶ THIS THIRD QUESTION in the water-treatment series discusses boiler scale, where it comes from, and why it forms.

Goodwater Laboratory
Drum City, U. S. A.
Dear Chemist:

An argument arose on my shift last night as to how scale is formed in a boiler. Some waters that are reported as containing a lot of solids do not form scale, while others that seemingly contain very few solids give lots of trouble. Please explain this in simple nontechnical language.

Yours truly,
Walter Tender

Dear Walter:

Water may contain four kinds of solids:

1. Suspended solids (mud, clay and sand). They settle out readily and collect on the bottom of the boiler or in the mud drum.

2. Dissolved organic compounds (tannins, sugar, sewage): These do not normally settle out.

3. Dissolved inorganic compounds that come out of solution only when most of the water is removed (salt, soda ash, potassium compounds).

4. Dissolved inorganic compounds that are thrown down by heat, and stick fast to the hottest surfaces that they come in contact with. These are the scale formers and consist primarily of lime and magnesium salts, both carbonates and sulphates, also reported as "hardness."

First class of compounds are sometimes a severe nuisance rather than a danger. They do not result in scale but quickly settle to the bottom and are removed by blowing down.

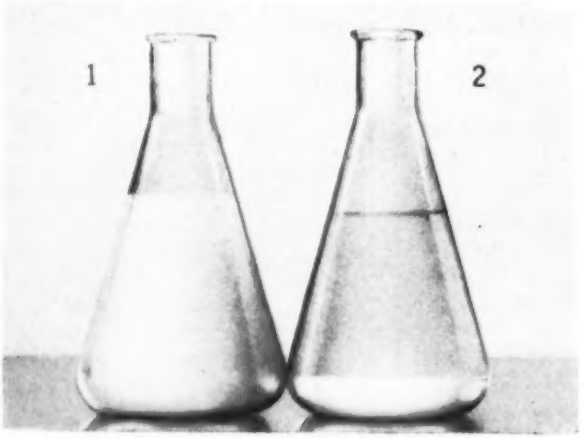
Second class give trouble, such as foaming. While they may be brought out with the mud they are not primarily scale formers.

Third class, if present in big quantities and if the amount of makeup is large, accumulate in the boiler and may come out of solution, but are not scale formers.

The last, however, form scale and often drag down mud and other compounds to form additional and more troublesome deposits. Even small amounts of these compounds give trouble, increasing in degree with increasing pressure and boiler capacity.

Thus, a water containing large amounts of the first three classes, but very little of the last, produces practically no scale, Table I. But one containing relatively small amounts of total solids, but practically all of them in the last class, produces scale, Table II.

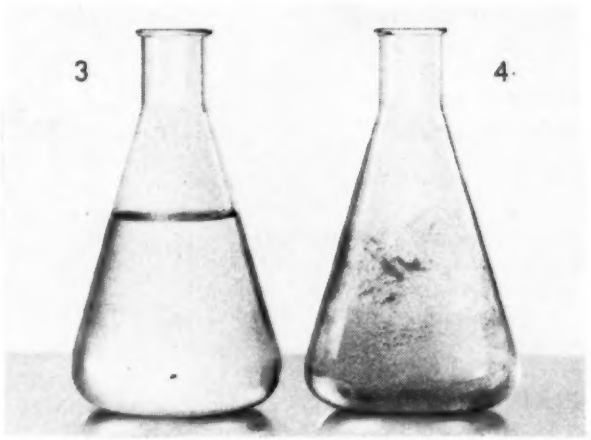
Yours truly,
Chemist
Goodwater Laboratory




### Table I—Boiling Does Not Form Scale

Fig. 1 contains the raw water analyzed below. When heated it settles out like that in Fig. 2. Boiling does not cause scale to form.

| *Impurities* | *Ppm* |
|---|---|
| Total solids | 500 |
| Suspended solids | 100 |
| Dissolved solids | 400 |
| Organic solids | 150 |
| Lime and magnesium salts (hardness) | 25 |
| Sodium and potassium salts | 225 |



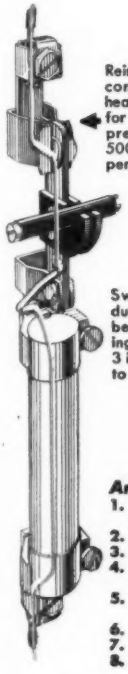

### Table II—Boiling Does Form Scale

Fig. 3 contains the raw water that is analyzed below. When boiled it forms scale as shown in Fig. 4.

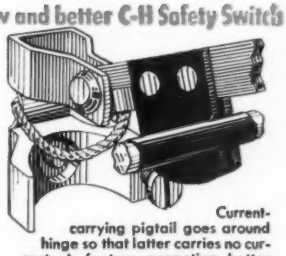
| *Impurities* | *Ppm* |
|---|---|
| Total solids | 200 |
| Suspended solids | — |
| Dissolved solids | 200 |
| Organic solids | 10 |
| Lime and magnesium salts (hardness) | 175 |
| Sodium and potassium salts | 15 |

# A *New* AND *Better* SAFETY SWITCH

Features of the new and better C-H Safety Switch



Reinforced stationary contact jaws have heavy non-ferrous clips for permanent contact pressure. Withstand 500° F operating temperatures.



Current-carrying pigtail goes around hinge so that latter carries no current. A feature promoting better operation and longer life in Type A switches.

Switch heating reduced by cutting number of current carrying screw joints to only 3 in type A switches—to only 4 in type C.

Perfected arc snuffer confines arc to restricted space and wipes remaining arc from blade as switch is opened. Snuffer readily removed to inspect jaw contact.

***And in Addition . . .***

1. New modern case design that matches Cutler-Hammer motor control styling.
2. Knockouts that really knock out.
3. Front operation for close ganging.
4. Plenty of room and easy access to shape up wires inside. Easy installation.
5. Knife type blades, solderless lugs, screw type fuse clamps (Type A), strong clips.
6. All parts cadmium plated against corrosion.
7. Assured positive and firm contact even after long use.
8. Contacts on Type A switches are silver plated.

To beat the heat that *all* safety switches generate while they are "on" . . . Cutler-Hammer Engineers designed a NEW Safety Switch. Their first step was to plan a switch mechanism that would carry its load with a new low minimum of heating. Their second step was to build the mechanism so that it would far better withstand the heat produced by the fuses in normal operation. Finally they added plus features which a thorough investigation over a long period of time showed that contractors, electricians and service men want.

The result is an outstanding switch that offers better performance, longer life, easier installation, better appearance, a new measure of safety . . . a switch such as you have never encountered before. Why don't you take the measure of its quality in your very next installation? At Cutler-Hammer wholesalers everywhere. CUTLER-HAMMER, Inc., 1358 St. Paul Ave., Milwaukee 1, Wisconsin.

CUTLER-HAMMER
SAFETY SWITCHES
C-H

# CENTRIFUGAL PUMP Q AND A FOR POWER ENGINEERS

By I J Karassik and Roy Carter

## 15—Installation and Alignment

*Fifteenth in a monthly series by Igor J Karassik and Roy Carter, Worthington application engineers. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies.*

*Q 1—Does the manufacturer test a centrifugal pump under operating conditions before shipment?*

A—Performance of all equipment is guaranteed by the manufacturer. Whenever possible, he conducts tests at full operating conditions. However, if power for such conditions is beyond that available, reduced-speed tests are run and the results projected to full operating conditions by accepted hydraulic laws. Frequently cold water is used to test a pump that is to handle hot water or liquids other than water. Corrections are then made for power consumption, and performance is checked under suction conditions similar to those of the intended installation. On some lines of small low-cost pumps, which are built in quantity for stock, one out of ten units may be tested to check performance.

*Q 2—Are there general rules for the preferred location of a pump?*

A—Yes, here are five:

1. Install pump in a light, dry, clean room. If the location is cramped, dirty, wet or poorly lighted, a unit is difficult to dismantle and repair, and likely to be neglected by the operators.

2. If a unit must be placed where it might be submerged, install a wet-pit pump; or make provision to remove incoming water, using auxiliary wet-pit drainage pumps, so neither the main pump nor its driver will be flooded.

3. If a motor-driven unit is to operate in a damp or moist location, select the right motor for the conditions. Pumps and their drivers, for installation in the open, are specially constructed to withstand exposure to weather, and usually are readily available from electrical-equipment manufacturers.

4. Locate pump as close as possible to the supply source. If possible, place it below the suction reservoir's liquid level. Always be guided by the manufacturer's recommendations for suction conditions.

5. Install it where a substantial foundation can be provided.

*Q 3—Are a centrifugal pump and its driver checked for alignment at the factory before shipment?*

A—Yes. When a unit consisting of pump, base, coupling and driver is assembled at the factory, the baseplate is

(*Continued on page* 118)

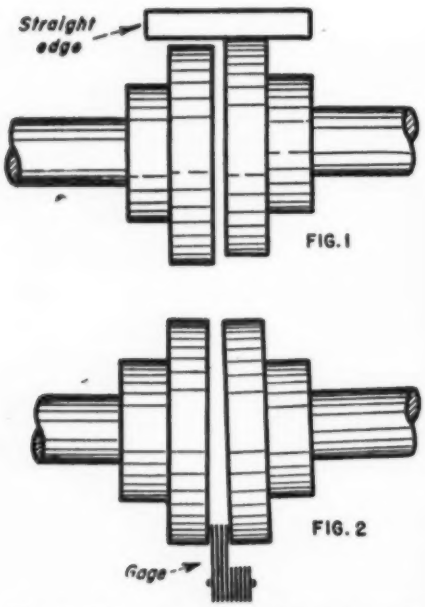



**Fig. 1—Place a straightedge across the top and sides of the coupling to check for axial alignment. Fig. 2—When coupling faces are parallel, the true angular alignment has been obtained**

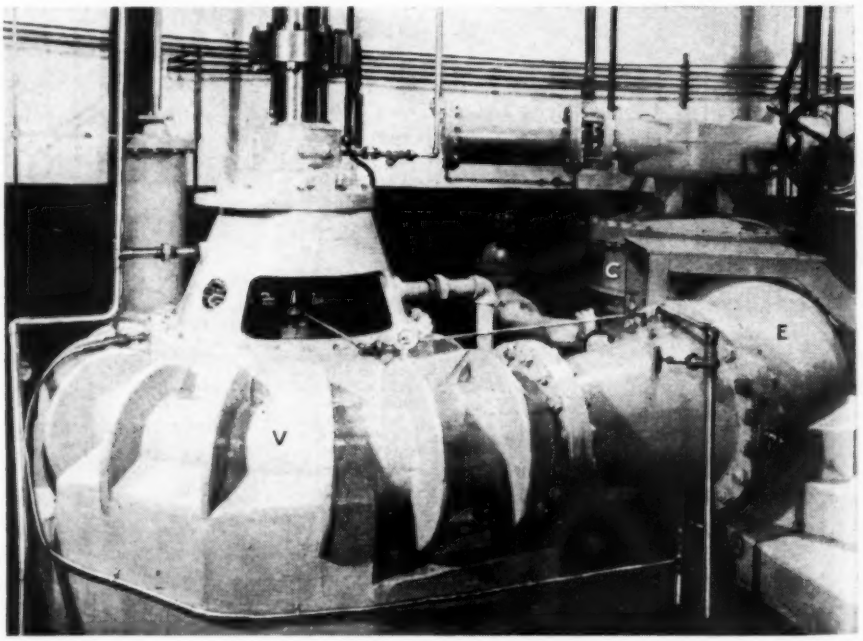



**Fig. 3—To transmit the high-pressure hydraulic thrust released by a flexible-pipe connection in the discharge line beyond cone valve, C, the 45-deg elbow, E, and the pump's volute casing, V, are anchored in the concrete foundation as shown**

# *Another* MAINTENANCE *Record* for "GUN-PAKT" JOINTS!

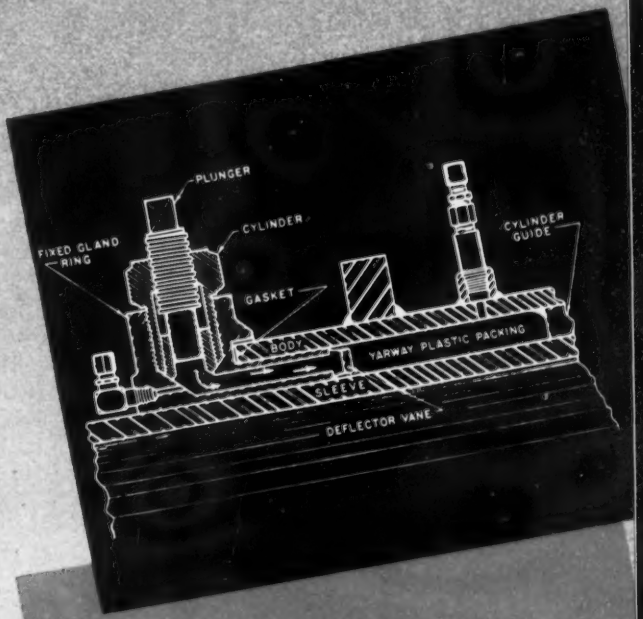
**WESTERN UTILITY MAINTAINS**
**ALL YARWAY EXPANSION JOINTS**
**AT COST OF $1.50 PER MONTH FOR PACKING**

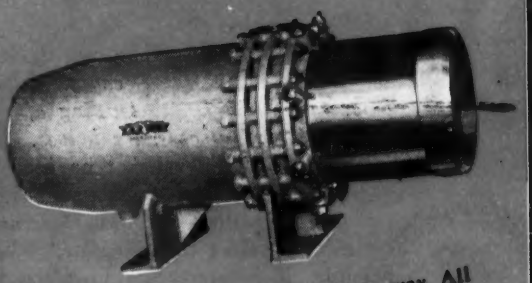
Over the last 12 years this company has installed 121 Yarway Gun-Pakt Expansion Joints, ranging in size from 3" to 20". During that period they have had to purchase only 76 pounds of packing for these joints . . . at a cost of approximately $1.50 per month. That's to service *all* the Gun-Pakt joints!

The Gun-Pakt feature is more than an idea—it is a practical improvement in expansion joint design that has saved thousands of dollars in operating and maintenance costs to public utilities and others who have installed them in steam distribution systems. With Gun-Pakt joints there is no need for costly shutdowns for repacking. *They can be serviced under full steam pressure.* Insert a packing plug . . . twist a wrench—the joint's tight, the job's done.

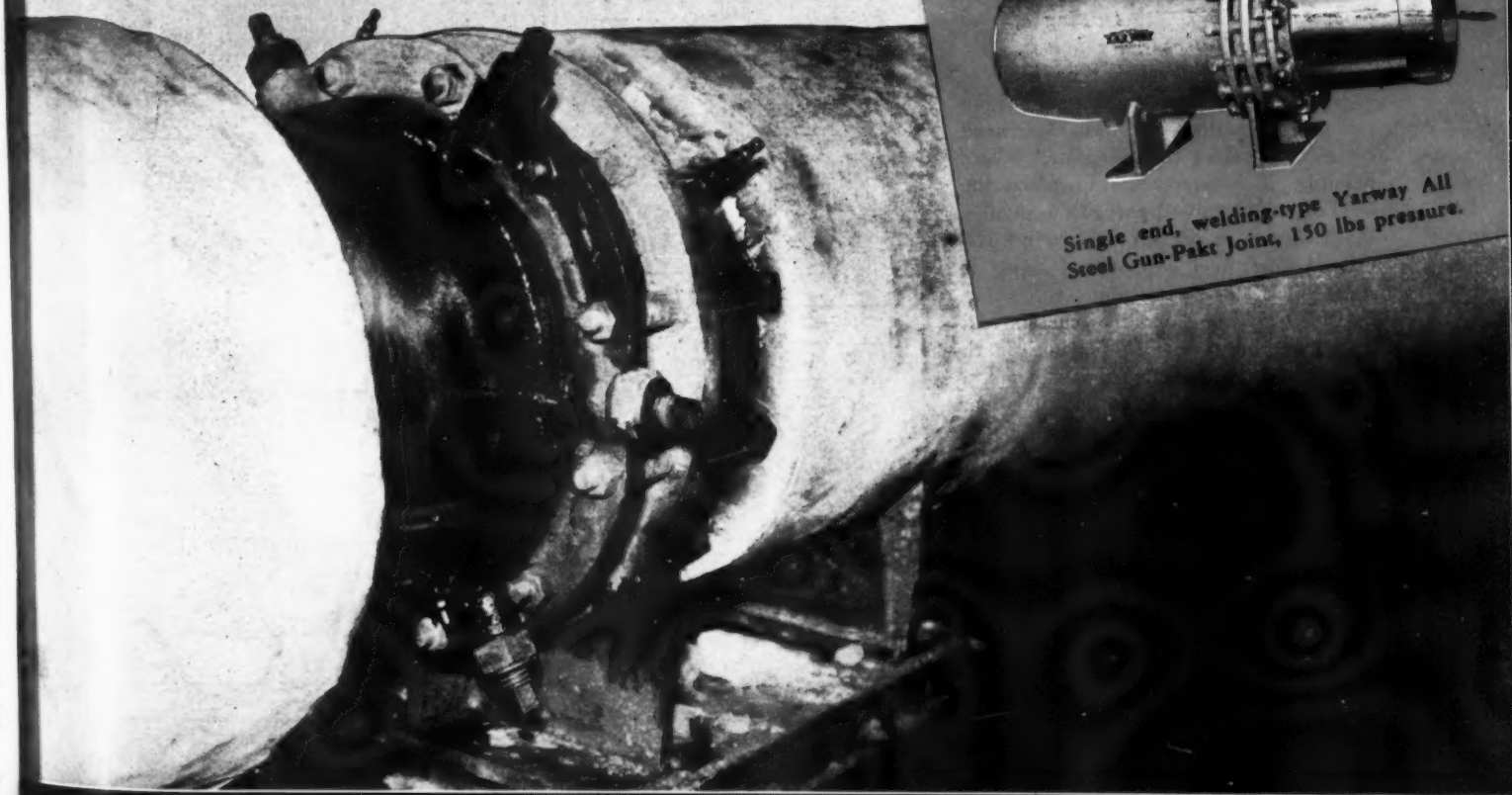
For the full story on Yarway Gun-Pakt Expansion Joints, write for Bulletin EJ-1911.

**YARNALL-WARING COMPANY**
**100 Mermaid Ave., Philadelphia 18, Pa.**



Single end, welding-type Yarway All Steel Gun-Pakt Joint, 150 lbs pressure.



**YARWAY GUN-PAKT EXPANSION JOINT**

# PUMP Q&A

*Continued*

placed on a flat, even surface. Pump and driver are mounted on it and the coupling halves accurately aligned. Shims are used under the mounting surfaces of pump and driver where necessary to obtain alignment. The pump, but not the driver, is generally doweled to the baseplate at the factory. The driver is not doweled because field duplication of factory alignment is thus simplified.

*Q 4—Why should a pump be realigned in the field?*

A—All baseplates are flexible, and subject to shipping strains. When a unit is installed, a careful check is necessary to determine whether factory alignment has been disturbed.

*Q 5—How is a pump leveled on its foundation?*

A—Pumps are generally shipped mounted, and it is usually unnecessary with units of moderate size to remove pump or driver from its baseplate when leveling. Place the unit over its foundation, and support it on short strips of steel or shim stock close to the foundation bolts. Allow from 0.75- to 2-in. space between baseplate and foundation top for grouting. Have the shim stock extend across the supporting edges of the baseplate. *Remove coupling bolts before proceeding with leveling of unit and alignment of coupling halves.*

A small spirit level can be used on the projecting edges of pads supporting pump and motor feet, when scraped clean, for leveling the baseplate. Where possible, it is preferable to place the level on some exposed part of the pump's shaft, sleeve or planed surface of casing. Adjust steel supporting strips or shim stock under baseplate till pump shaft is level, the flanges of suction and discharge nozzles vertical or horizontal, as required, and observe that the pump is at the specified height and location. When the baseplate has been leveled make the nuts of the foundation bolts handtight.

While leveling the pump and base, maintain accurate alignment of unbolted coupling halves on pump and driver shafts.

*Q 6—How are centrifugal pump and its driver aligned?*

A—Make this alignment with the pump and driver coupling disconnected. Revolve the pump and driver rotors by hand to insure that they run freely. Place a straightedge across the top and sides of the coupling, Fig. 1. Check the coupling-halves' faces for parallelism by a tapered thickness gage or feeler gages, Fig. 2. Alignment can also be checked with a dial indicator clamped to one half of the coupling and resting on the other half.

When the coupling peripheries are true circles of equal diameter, and the faces flat, exact alignment exists when a straightedge lies squarely across the rims at any point and the distance between the faces is equal at all points. If one coupling-half is higher than the other, the difference may be determined by the straightedge and feeler gages. If the faces are not parallel, the thickness gage or feelers show a variation in the distance apart at different points.

Alignment must be rechecked after suction and discharge piping have been bolted to the pump, to test the effect of piping strains. When handling hot liquids, disconnect the nozzle flanges after unit has been in service, to check direction in which the piping expansion is acting. Correct for strain effect as required to obtain true flange alignment.

*Q 7—What precautions must be observed when a pump and its driver operate at appreciably different temperatures?*

A—Where a steam turbine drives a pump make final alignment with driver heated to its operating temperature. If this is not possible at time of alignment, make allowance for the temperature effect by setting the turbine shaft when cold a proper amount lower than the pump shaft. Similarly, if pump handles hot liquids, allowances must be made for the shaft being elevated when the pump expands. In any case, check alignment when unit is at operating temperature and adjusted as required before placing pump in service. Steam and exhaust piping expands and the installation must be made so that the turbine nozzles are not subjected to piping strains.

*Q 8—Should pump and driver alignment be rechecked occasionally?*

A—Yes. Piping strains may develop causing misalignment after a unit has been operating for a time. This is especially true when hot liquids are handled as there is likelihood of growth or change in piping shape. Disconnect pipe flanges at the pump to find out the direction of piping expansion, and make adjustments

(*Continued on page* 142)

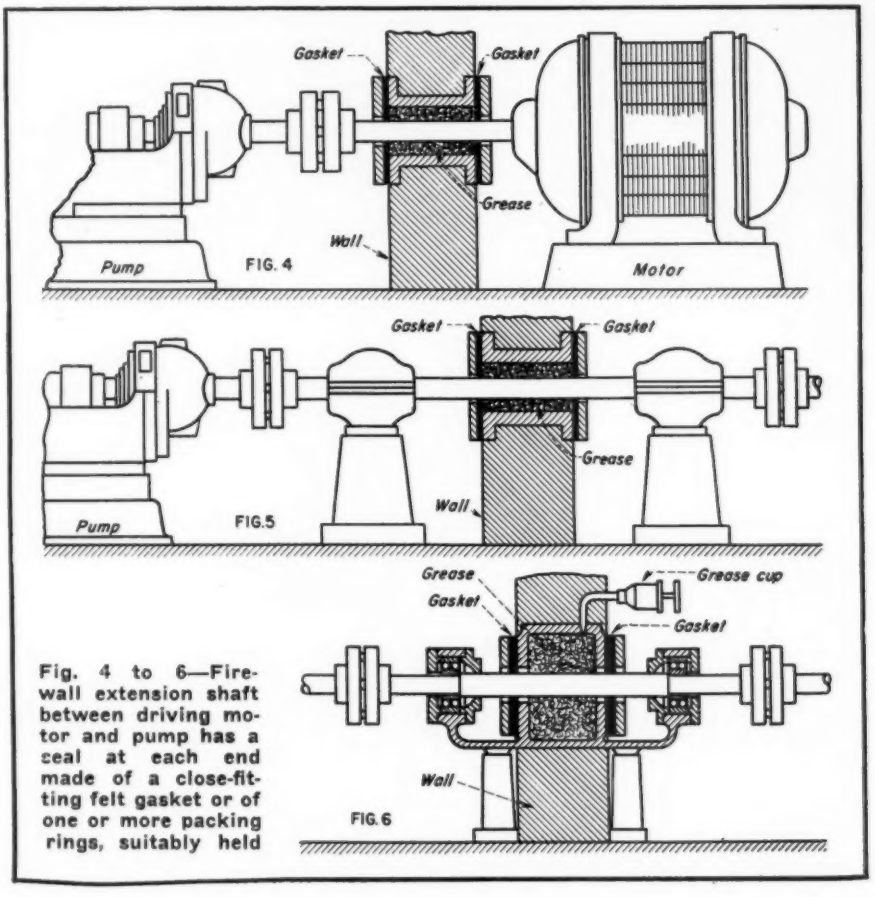
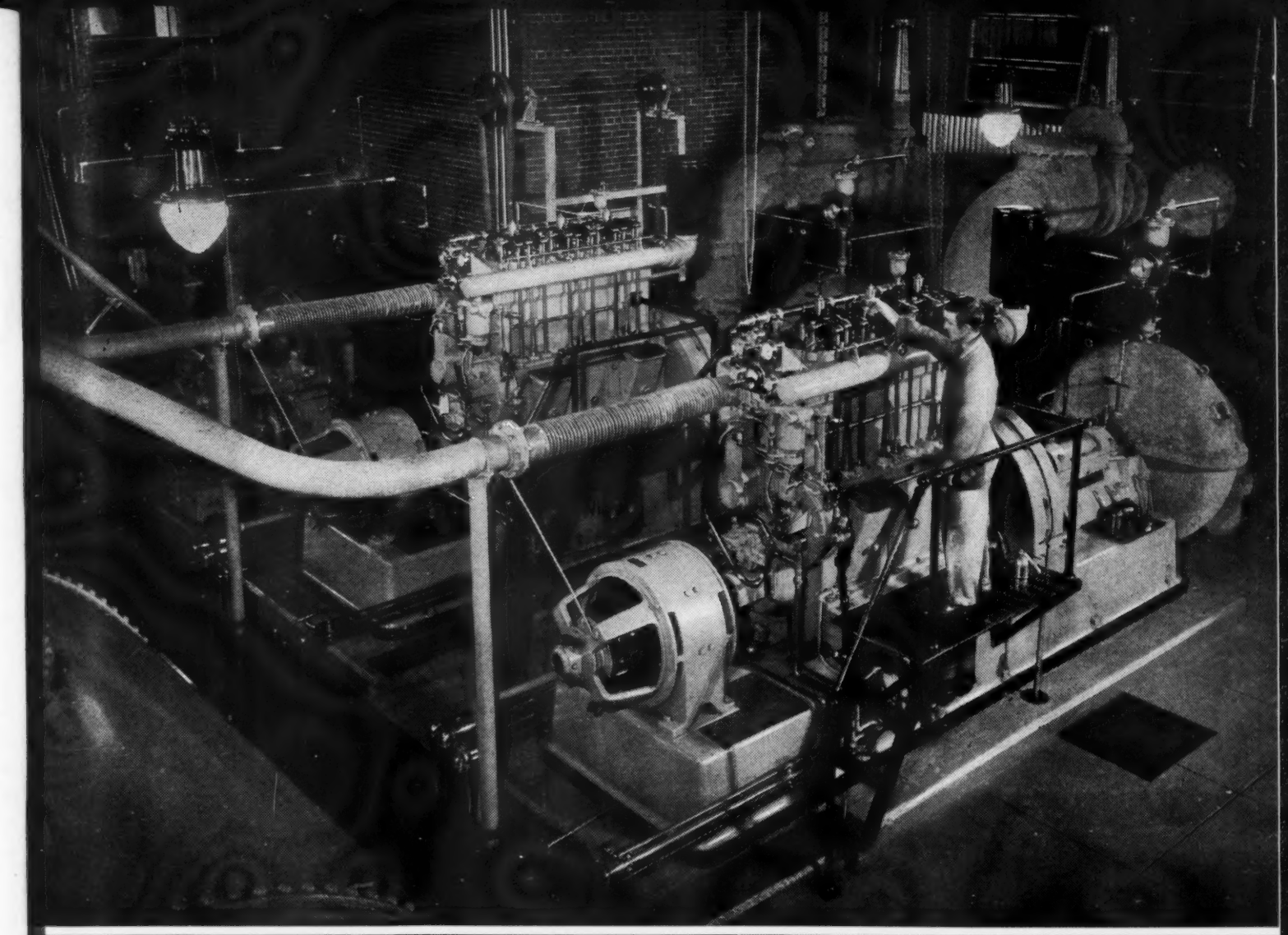



**Fig. 4 to 6—Firewall extension shaft between driving motor and pump has a seal at each end made of a close-fitting felt gasket or of one or more packing rings, suitably held**



# *Stops* SLUDGE... *Chases* CARBON

## SUN DIESEL LUBRICANT...

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**A Sun Engineer** was called recently to a large sewage plant. Two 125-horsepower Diesel engines, connected to centrifugal pumps, were pumping 10,400 gallons a minute.

**But sludge and carbon** were causing chronic engine-repairs and were crippling the plant. Oil consumption was high.

**After 3,974 hours** of operation on a specially developed Sun Diesel oil, engineers reported perfect lubrication, freedom from sludge, no carbon, no repairs, no replacements, no overhauls, and very low consumption.

**On important power-jobs** in municipal plants, or in mills, mines, and factories, more and more experienced engineers are putting their trust in Sun lubricants. For every type of power-equipment, Sun has the right lubricant for peak performance . . . rock-bottom maintenance. Call the Sun Engineer near you, or write . . .

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# MATH TIPS

**PHIL SWAIN GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS**

## ⑫—How to Find Logarithms

▶ BEFORE STUDYING THIS PAGE, read or review "Logarithms: Time-Saving Invention," p 120, April POWER.

Below is a standard 4-place table (4 decimal places) of logs from 1 to 10 by hundredths. For example, the log of 7.32 is 0.8645 and the log of 1.86 is 0.2695.

*Problem:* What is log 3.276?

Here it is necessary to interpolate; that is, find a value between two adjacent values in the table. We have:

| | |
|---|---|
| Log 3.28 = | 0.5159 |
| Log 3.27 = | 0.5145 |
| Difference | .0014 |

It is clear that log 3.276 must be: $0.5145+0.6\times0014 = 0.5145+.0008 = 0.5153$

The reverse process uses interpolation to find the number which has a given log.

*Problem:* Of what number is 0.7799 the log?

| | |
|---|---|
| Log 6.03 = | 0.7803 |
| Log 6.02 = | 0.7796 |
| Difference .01 | 0.0007 |

Note that 0.7799 — 0.7796 = 0.0003, so the number must be 6.02 + 3/7 of .01. Nearest single-place decimal to 3/7 is 0.4, so the correct number is 6.024.

The same table serves for any number larger than 10. Thus log 32,760 = ? As noted, log 3.276 = 0.5153. Now 32,760 is 3.276 × 10,000, so log 32,760 is:

0.5153 + log 10,000 = 0.5153 + 4 = 4.5153.

*Here is the rule for the logs of numbers greater than* 10: Point off to make a number between 1 and 10, and read its log from the table below. Before the decimal point in the log put a number that is one less than the number of digits before the decimal point in the given number.

*In the case of a number less than* 1, take the log from the table in the manner just indicated. Then place before the decimal point of the log a number one more than the number of zeros between the decimal point of the number and the first digit not a zero. Put a minus sign *over* the number before the decimal point.

*Problem:* What is log 0.000654?

Log 6.54 = 0.8156. The number 0.000654 has 3 zeros between decimal point and first digit not a zero, so the log is $\bar{4}.8156$. The minus sign over the 4 indicates that the 4 is minus while the part of the log after the point is plus. Meaning and use of this will be explained next month with practical examples of multiplication and division.

## Four-place Common Logarithms of Numbers

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Ave. diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 0 | 0.0000 | 0043 | 0086 | 0128 | 0170 | 0212 | 0253 | 0294 | 0334 | 0374 | 42 |
| 1 1 | 0414 | 0453 | 0492 | 0531 | 0569 | 0607 | 0645 | 0682 | 0719 | 0755 | 38 |
| 1 2 | 0792 | 0828 | 0864 | 0899 | 0934 | 0969 | 1004 | 1038 | 1072 | 1106 | 35 |
| 1 3 | 1139 | 1173 | 1206 | 1239 | 1271 | 1303 | 1335 | 1367 | 1399 | 1430 | 32 |
| 1 4 | 1461 | 1492 | 1523 | 1553 | 1584 | 1614 | 1644 | 1673 | 1703 | 1732 | 30 |
| 1 5 | 1761 | 1790 | 1818 | 1847 | 1875 | 1903 | 1931 | 1959 | 1987 | 2014 | 28 |
| 1 6 | 2041 | 2068 | 2095 | 2122 | 2148 | 2175 | 2201 | 2227 | 2253 | 2279 | 26 |
| 1 7 | 2304 | 2330 | 2355 | 2380 | 2405 | 2430 | 2455 | 2480 | 2504 | 2529 | 25 |
| 1 8 | 2553 | 2577 | 2601 | 2625 | 2648 | 2672 | 2695 | 2718 | 2742 | 2765 | 23 |
| 1 9 | 2788 | 2810 | 2833 | 2856 | 2878 | 2900 | 2923 | 2945 | 2967 | 2989 | 22 |
| 2 0 | 3010 | 3032 | 3054 | 3075 | 3096 | 3118 | 3139 | 3160 | 3181 | 3201 | 21 |
| 2 1 | 3222 | 3243 | 3263 | 3284 | 3304 | 3324 | 3345 | 3365 | 3385 | 3404 | 20 |
| 2 2 | 3424 | 3444 | 3464 | 3483 | 3502 | 3522 | 3541 | 3560 | 3579 | 3598 | 19 |
| 2 3 | 3617 | 3636 | 3655 | 3674 | 3692 | 3711 | 3729 | 3747 | 3766 | 3784 | 18 |
| 2 4 | 3802 | 3820 | 3838 | 3856 | 3874 | 3892 | 3909 | 3927 | 3945 | 3962 | 17 |
| 2 5 | 3979 | 3997 | 4014 | 4031 | 4048 | 4065 | 4082 | 4099 | 4116 | 4133 | |
| 2 6 | 4150 | 4166 | 4183 | 4200 | 4216 | 4232 | 4249 | 4265 | 4281 | 4298 | 16 |
| 2 7 | 4314 | 4330 | 4346 | 4362 | 4378 | 4393 | 4409 | 4425 | 4440 | 4456 | |
| 2 8 | 4472 | 4487 | 4502 | 4518 | 4533 | 4548 | 4564 | 4579 | 4594 | 4609 | 15 |
| 2 9 | 4624 | 4639 | 4654 | 4669 | 4683 | 4698 | 4713 | 4728 | 4742 | 4757 | |
| 3 0 | 4771 | 4786 | 4800 | 4814 | 4829 | 4843 | 4857 | 4871 | 4886 | 4900 | 14 |
| 3 1 | 4914 | 4928 | 4942 | 4955 | 4969 | 4983 | 4997 | 5011 | 5024 | 5038 | |
| 3 2 | 5052 | 5065 | 5079 | 5092 | 5105 | 5119 | 5132 | 5145 | 5159 | 5172 | 13 |
| 3 3 | 5185 | 5198 | 5211 | 5224 | 5237 | 5250 | 5263 | 5276 | 5289 | 5302 | |
| 3 4 | 5315 | 5328 | 5340 | 5353 | 5366 | 5378 | 5391 | 5403 | 5416 | 5428 | |
| 3 5 | 5441 | 5453 | 5465 | 5478 | 5490 | 5502 | 5515 | 5527 | 5539 | 5551 | 12 |
| 3 6 | 5563 | 5575 | 5587 | 5599 | 5611 | 5623 | 5635 | 5647 | 5658 | 5670 | |
| 3 7 | 5682 | 5694 | 5705 | 5717 | 5729 | 5740 | 5752 | 5763 | 5775 | 5786 | |
| 3 8 | 5798 | 5809 | 5821 | 5832 | 5843 | 5855 | 5866 | 5877 | 5888 | 5899 | 11 |
| 3 9 | 5911 | 5922 | 5933 | 5944 | 5955 | 5966 | 5977 | 5988 | 5999 | 6010 | |
| 4 0 | 6021 | 6031 | 6042 | 6053 | 6064 | 6075 | 6085 | 6096 | 6107 | 6117 | |
| 4 1 | 6128 | 6138 | 6149 | 6160 | 6170 | 6180 | 6191 | 6201 | 6212 | 6222 | 10 |
| 4 2 | 6232 | 6243 | 6253 | 6263 | 6274 | 6284 | 6294 | 6304 | 6314 | 6325 | |
| 4 3 | 6335 | 6345 | 6355 | 6365 | 6375 | 6385 | 6395 | 6405 | 6415 | 6425 | |
| 4 4 | 6435 | 6444 | 6454 | 6464 | 6474 | 6484 | 6493 | 6503 | 6513 | 6522 | |
| 4 5 | 6532 | 6542 | 6551 | 6561 | 6571 | 6580 | 6590 | 6599 | 6609 | 6618 | |
| 4 6 | 6628 | 6637 | 6646 | 6656 | 6665 | 6675 | 6684 | 6693 | 6702 | 6712 | |
| 4 7 | 6721 | 6730 | 6739 | 6749 | 6758 | 6767 | 6776 | 6785 | 6794 | 6803 | 9 |
| 4 8 | 6812 | 6821 | 6830 | 6839 | 6848 | 6857 | 6866 | 6875 | 6884 | 6893 | |
| 4 9 | 6902 | 6911 | 6920 | 6928 | 6937 | 6946 | 6955 | 6964 | 6972 | 6981 | |
| 5 0 | 0.6990 | 6998 | 7007 | 7016 | 7024 | 7033 | 7042 | 7050 | 7059 | 7067 | 9 |
| 5 1 | 7076 | 7084 | 7093 | 7101 | 7110 | 7118 | 7126 | 7135 | 7143 | 7152 | 8 |
| 5 2 | 7160 | 7168 | 7177 | 7185 | 7193 | 7202 | 7210 | 7218 | 7226 | 7235 | |
| 5 3 | 7243 | 7251 | 7259 | 7267 | 7275 | 7284 | 7292 | 7300 | 7308 | 7316 | |
| 5 4 | 7324 | 7332 | 7340 | 7348 | 7356 | 7364 | 7372 | 7380 | 7388 | 7396 | |

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Ave. diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.5 | 7404 | 7412 | 7419 | 7427 | 7435 | 7443 | 7451 | 7459 | 7466 | 7474 | |
| 5.6 | 7482 | 7490 | 7497 | 7505 | 7513 | 7520 | 7528 | 7536 | 7543 | 7551 | |
| 5.7 | 7559 | 7566 | 7574 | 7582 | 7589 | 7597 | 7604 | 7612 | 7619 | 7627 | |
| 5.8 | 7634 | 7642 | 7649 | 7657 | 7664 | 7672 | 7679 | 7686 | 7694 | 7701 | 7 |
| 5.9 | 7709 | 7716 | 7723 | 7731 | 7738 | 7745 | 7752 | 7760 | 7767 | 7774 | |
| 6.0 | 7782 | 7789 | 7796 | 7803 | 7810 | 7818 | 7825 | 7832 | 7839 | 7846 | |
| 6.1 | 7853 | 7860 | 7868 | 7875 | 7882 | 7889 | 7896 | 7903 | 7910 | 7917 | |
| 6.2 | 7924 | 7931 | 7938 | 7945 | 7952 | 7959 | 7966 | 7973 | 7980 | 7987 | |
| 6.3 | 7993 | 8000 | 8007 | 8014 | 8021 | 8028 | 8035 | 8041 | 8048 | 8055 | |
| 6.4 | 8062 | 8069 | 8075 | 8082 | 8089 | 8096 | 8102 | 8109 | 8116 | 8122 | |
| 6.5 | 8129 | 8136 | 8142 | 8149 | 8156 | 8162 | 8169 | 8176 | 8182 | 8189 | |
| 6.6 | 8195 | 8202 | 8209 | 8215 | 8222 | 8228 | 8235 | 8241 | 8248 | 8254 | |
| 6.7 | 8261 | 8267 | 8274 | 8280 | 8287 | 8293 | 8299 | 8306 | 8312 | 8319 | 6 |
| 6.8 | 8325 | 8331 | 8338 | 8344 | 8351 | 8357 | 8363 | 8370 | 8376 | 8382 | |
| 6.9 | 8388 | 8395 | 8401 | 8407 | 8414 | 8420 | 8426 | 8432 | 8439 | 8445 | |
| 7.0 | 8451 | 8457 | 8463 | 8470 | 8476 | 8482 | 8488 | 8494 | 8500 | 8506 | |
| 7.1 | 8513 | 8519 | 8525 | 8531 | 8537 | 8543 | 8549 | 8555 | 8561 | 8567 | |
| 7.2 | 8573 | 8579 | 8585 | 8591 | 8597 | 8603 | 8609 | 8615 | 8621 | 8627 | |
| 7.3 | 8633 | 8639 | 8645 | 8651 | 8657 | 8663 | 8669 | 8675 | 8681 | 8686 | |
| 7.4 | 8692 | 8698 | 8704 | 8710 | 8716 | 8722 | 8727 | 8733 | 8739 | 8745 | |
| 7.5 | 8751 | 8756 | 8762 | 8768 | 8774 | 8779 | 8785 | 8791 | 8797 | 8802 | |
| 7.6 | 8808 | 8814 | 8820 | 8825 | 8831 | 8837 | 8842 | 8848 | 8854 | 8859 | |
| 7.7 | 8865 | 8871 | 8876 | 8882 | 8887 | 8893 | 8899 | 8904 | 8910 | 8915 | |
| 7.8 | 8921 | 8927 | 8932 | 8938 | 8943 | 8949 | 8954 | 8960 | 8965 | 8971 | |
| 7.9 | 8976 | 8982 | 8987 | 8993 | 8998 | 9004 | 9009 | 9015 | 9020 | 9025 | 5 |
| 8.0 | 9031 | 9036 | 9042 | 9047 | 9053 | 9058 | 9063 | 9069 | 9074 | 9079 | |
| 8.1 | 9085 | 9090 | 9096 | 9101 | 9106 | 9112 | 9117 | 9122 | 9128 | 9133 | |
| 8.2 | 9138 | 9143 | 9149 | 9154 | 9159 | 9165 | 9170 | 9175 | 9180 | 9186 | |
| 8.3 | 9191 | 9196 | 9201 | 9206 | 9212 | 9217 | 9222 | 9227 | 9232 | 9238 | |
| 8.4 | 9243 | 9248 | 9253 | 9258 | 9263 | 9269 | 9274 | 9279 | 9284 | 9289 | |
| 8.5 | 9294 | 9299 | 9304 | 9309 | 9315 | 9320 | 9325 | 9330 | 9335 | 9340 | |
| 8.6 | 9345 | 9350 | 9355 | 9360 | 9365 | 9370 | 9375 | 9380 | 9385 | 9390 | |
| 8.7 | 9395 | 9400 | 9405 | 9410 | 9415 | 9420 | 9425 | 9430 | 9435 | 9440 | |
| 8.8 | 9445 | 9450 | 9455 | 9460 | 9465 | 9469 | 9474 | 9479 | 9484 | 9489 | |
| 8.9 | 9494 | 9499 | 9504 | 9509 | 9513 | 9518 | 9523 | 9528 | 9533 | 9538 | |
| 9.0 | 9542 | 9547 | 9552 | 9557 | 9562 | 9566 | 9571 | 9576 | 9581 | 9586 | |
| 9.1 | 9590 | 9595 | 9600 | 9605 | 9609 | 9614 | 9619 | 9624 | 9628 | 9633 | |
| 9.2 | 9638 | 9643 | 9647 | 9652 | 9657 | 9661 | 9666 | 9671 | 9675 | 9680 | |
| 9.3 | 9685 | 9689 | 9694 | 9699 | 9703 | 9708 | 9713 | 9717 | 9722 | 9727 | |
| 9.4 | 9731 | 9736 | 9741 | 9745 | 9750 | 9754 | 9759 | 9764 | 9768 | 9773 | |
| 9.5 | 9777 | 9782 | 9786 | 9791 | 9795 | 9800 | 9805 | 9809 | 9814 | 9818 | |
| 9.6 | 9823 | 9827 | 9832 | 9836 | 9841 | 9845 | 9850 | 9854 | 9859 | 9863 | 4 |
| 9.7 | 9868 | 9872 | 9877 | 9881 | 9886 | 9890 | 9894 | 9899 | 9903 | 9908 | |
| 9.8 | 9912 | 9917 | 9921 | 9926 | 9930 | 9934 | 9939 | 9943 | 9948 | 9952 | |
| 9.9 | 9956 | 9961 | 9965 | 9969 | 9974 | 9978 | 9983 | 9987 | 9991 | 9996 | |

# *Stretch*

## YOUR PLANT'S STEAM CAPACITY . . . *SAFELY*

*with this* **Modern Electrical Control**

You keep air and fuel rates in accurately measured proportion to each other and in direct relation to the plant load, when you use Hays Automatic Combustion Control.

The result is simple and exceedingly profitable—you operate your boilers closer to their maximum capacity; and do it safely, much more economically than is possible under manual operation. You actually **stretch** your plant's steam capacity.

This is the truly modern system—wholly electrical: sensitive to the slightest change in steam demand, telegraphic in its instant measure of each variation and in its corrective response. It is simple to install, to maintain, to operate.

You recognize the advantages—steam pressure maintained constant, turbine room efficiency improved, and quality of processed product protected; fuel and maintenance costs appreciably lowered; clinker trouble greatly lessened; smoke negligible.

How you may enjoy these advantages is explained in Bulletin 46-605—contains helpful schematic drawings of 14 typical installations. Better send for it.

HAYS

THE MODERN SYSTEM . . . *it's electrical*

*Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

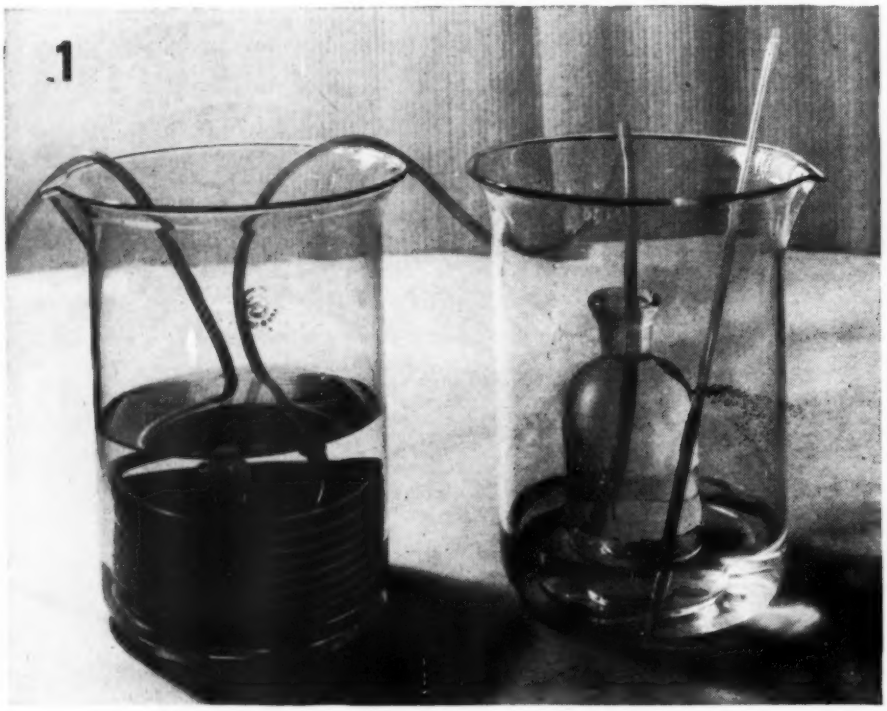
# HOW TO TAKE A DISSOLVED OXYGEN TEST SAMPLE

By C A NOLL, *Chief Chemist, W H and L D Betz*

▶ WHEN COLLECTING WATER for a dissolved oxygen test take extreme care to prevent pickup or loss of oxygen from the sample. If the water to be tested is hot, run it through a copper cooling coil so sample is exactly 70 F. Use copper or brass piping and fittings throughout, and feed water sample into test flask through *sulphur-free gum* tubing.

The entire system must be airtight. Use shellac on joints and connections, and flush the system to waste (without cooling) for half an hour.

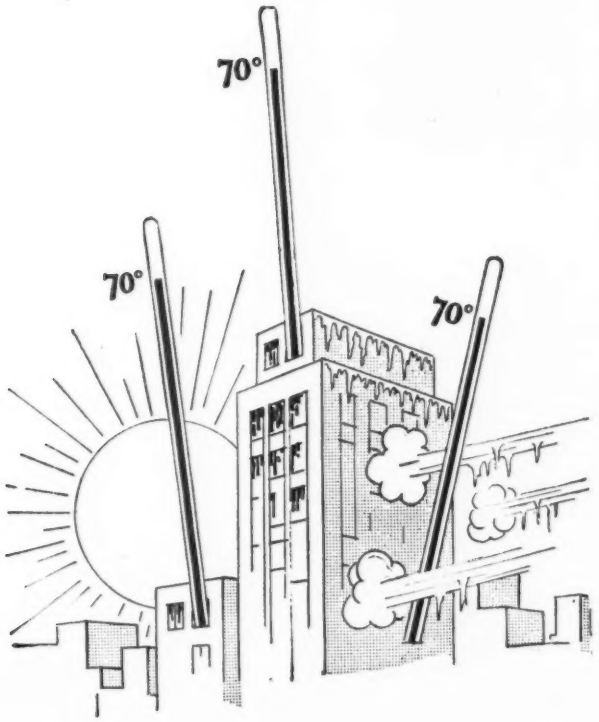
A portable cooling coil can be placed in a bucket or similar container into which a regulated flow of cooling water is discharged at the proper time. Use another container, having at least four times the capacity of the 10-oz sampling bottle to submerge the latter about two inches below the surface of the water.



**1** **Sampling bottle is first flushed with hot water (140-180 F) to be tested; then placed in submerging vessel. Insert a pencil thermometer and sampling hose in bottle. Adjust water flow so bottle fills and overflows once a minute. Maintain this rate. Now admit cooling water around the coil to produce sample water at exactly 70 F. See that no air bubbles are discharged into the bottle and allow sample to overflow submerging vessel about 10 min. Without shutting off sample, transfer the filling hose and thermometer from the bottle to outer container.**

**2** **Fill pipette to proper mark with manganous sulphate solution; leave a drop hanging on its end to prevent air entering. Insert pipette through water surface, deep into bottle. Discharge exactly 1 ml; slowly withdraw pipette and repeat at once with alkaline potassium-iodide solution, using *a clean pipette*.**

**3** **Wet glass stopper immediately with water in outer vessel; be sure no air bubbles adhere to it. Gently lower straight into bottle neck, allow to seat, then press home firmly. Remove sample bottle and mix contents by rotating gently. *Do not shake*. Bottle must not contain air bubbles. After mixing, again submerge bottle and let stand 3 min for floc to settle. Add 2 ml sulphuric acid with clean pipette and restopper. Remove bottle and rotate gently to dissolve floc; sample is ready for titration. Do this within 5 min to minimize errors from any interference.**




# Measure for Heating Values

Even, comfortable temperature—in every room; on every side of the building—in zero weather and on mildest days—with lower fuel bills . . . *The value of a Heating System is measured in Comfort balanced against Cost.*

The Webster Moderator System of Steam Heating delivers to *each* radiator only the amount of steam required to maintain an even, comfortable temperature regardless of exposure or changes in outside weather conditions. It is an automatic system with automatic controls. It won't overheat. It won't underheat.

The Webster Outdoor Thermostat automatically changes heating rate when outdoor temperature changes.

"Control-by-the-Weather is provided by an Outdoor Thermostat which automatically balances the delivery of steam to agree with every change in outdoor temperature.

## More Heat with Less Fuel

Seven out of ten large buildings in America (many less than ten years old) can get up to 33 per cent more heat out of the fuel consumed! . . . A book "Performance Facts" gives case studies—*before* and *after* figures—on 268 Webster Steam Heating installations. Write for it today. Address Dept. P-5.

WARREN WEBSTER & COMPANY, Camden, N. J.
Pioneers of the Vacuum System of Steam Heating : : Est. 1888
*Representatives in principal U. S. Cities : : Darling Bros., Ltd., Montreal, Canada*

*Fuel-Saving Starts With* CONTROL

AUTOMATIC Webster Heating Systems

# THE ARGUMENT CORNER

## Recirculate Oil To the Heater

MCC DID NOT DESCRIBE the service of his oil system (Reader's Problems, Dec 1945) but obviously his difficulty with time lag is caused by the rate of oil flow through the heater or the lack of capacity in his heating elements. Instead of an off-and-on control system he could improve his heating cycle by controlling the heating elements in two or three steps. A magnetic valve in the discharge line from the heater, with a relief valve discharging to the suction side of the pump, will recirculate some of the oil and keep the temperature more nearly constant.

*Bronx, N. Y.* H DEMLING

## Circulating-Water Pump Priming Systems

ON PAGE 123, POWER, Dec 1945, George I Smith describes how in emergencies he uses a vacuum-cleaning-system connection to exhaust air from his condenser circulating-water pumps. In our plant a system like this is a permanent one.

Each condenser has two circulating-water pumps with the tops of their casings connected to the priming line, as in diagram 2. Each pair of pumps is normally primed by a steam-jet ejector, but also has a permanent connection to a vacuum pump. A loop is provided in this connection to prevent water being siphoned over into the pump. This arrangement has given satisfactory service.

HOWARD T. LIVINGSTON

*Los Angeles, Calif.*

## Converting Centigrade Scale to Fahrenheit

THE METHOD of converting centigrade to fahrenheit scale (POWER, Sept 1945, p 126) seems unnecessarily complicated, so please allow me to enter the argument.

Let C = temperature in centigrade deg

F = temperature in fahrenheit deg

then $C = \frac{F - 32}{1.8}$

and $F = 32 + 1.8\ C$

These formulas are based on the very simple consideration of the points of correspondence, on both scales, for freezing and boiling water.

The centigrade scale is such that the freezing point of water is marked down as 0 C, and the boiling point as 100 C. The interval is divided into 100 equal parts. The same interval on the fahrenheit scale is divided into 180 equal parts (212 − 32). Thus 1 C equals 1.8 F. The reason for the number 32 is obvious from the accompanying sketch.

*Liege, Belgium* P VANHERK

## Superheated Heating Steam

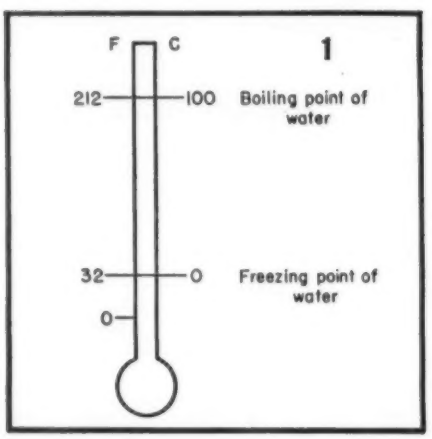
A GOOD DEAL OF HARM has been done by misleading articles about heat-transfer coefficients when using superheated steam for heating in closed heaters. Though heat transfer from superheated steam to a dry surface is relatively low per degree temperature difference, superheated steam will do any heating job that saturated steam can do at the same pressure, and in most instances do it better.

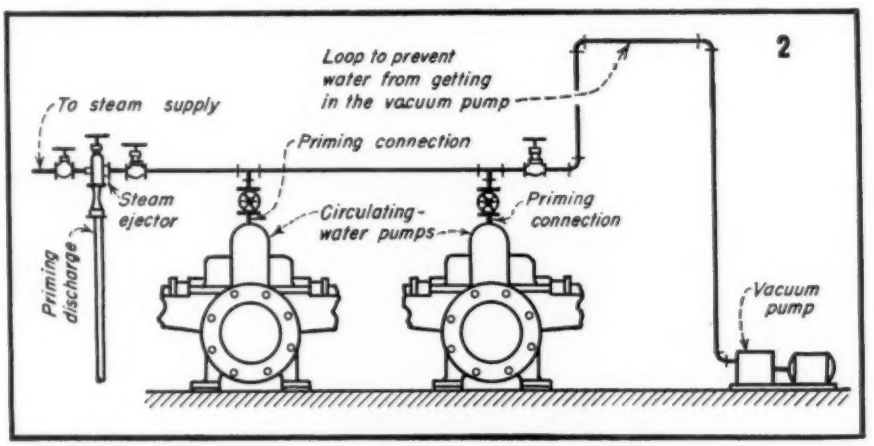
With saturated heating steam the heating-surface steam side is covered with condensate and the rate of heat transfer is figured on the basis of an over-all film of water. Because of the high heat-transfer rate from steam to water film we assume the film temperature to be the same as that of the saturated steam. Over-all rate of heat transfer equals the rate from condensate film to metal and from metal to fluid being heated. Thus for steam at 150 psig in a stage heater fitted with 1-in. OD tubes and with a velocity in the tubes of 7 ft per sec the heat flow resistance is about equally divided between the two surface resistances, and the metal temperature is about half way between the steam and water temperatures.

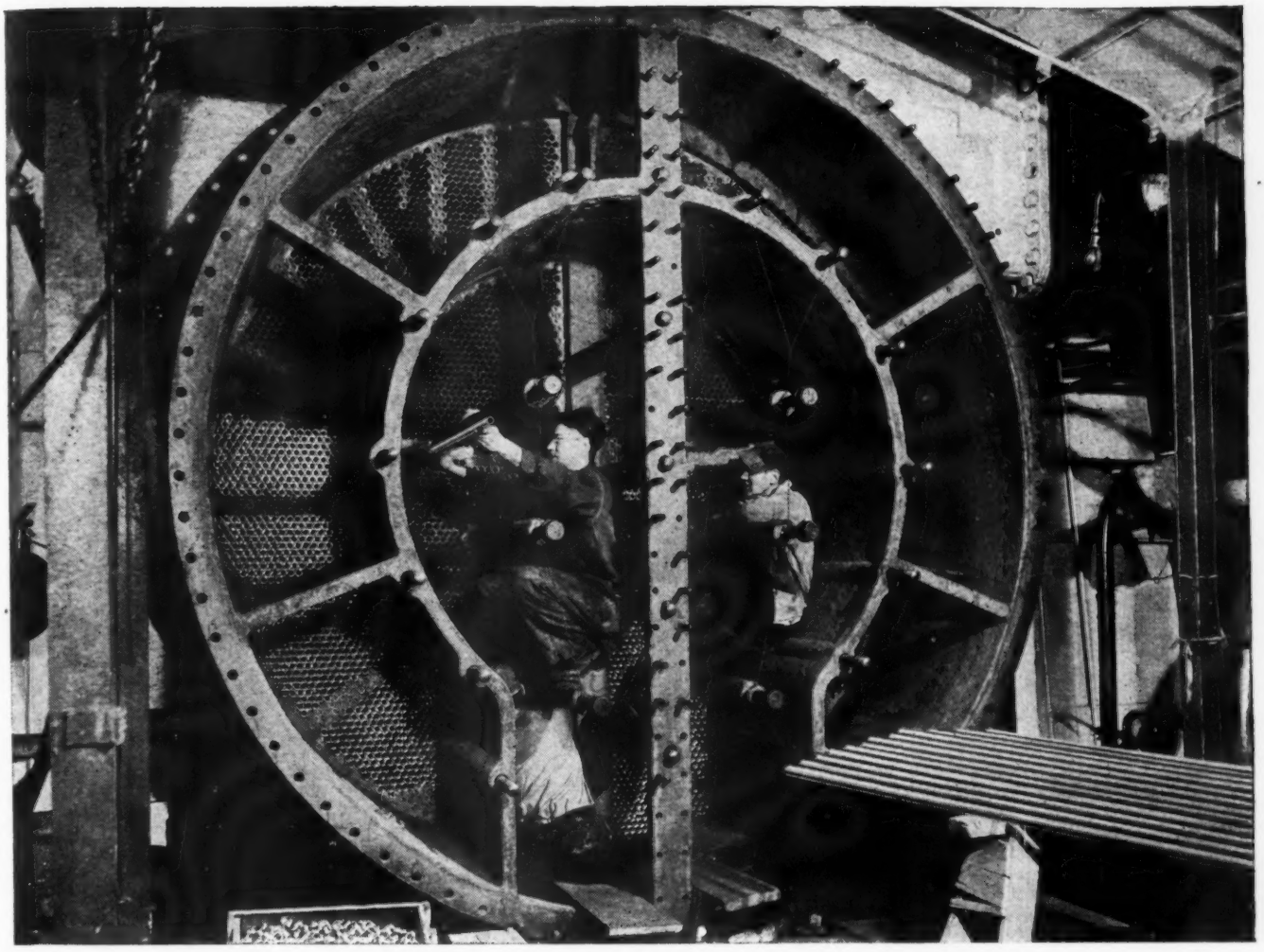
When condensing steam, *saturated* or *superheated*, the condensate wets the metal, and film-type condensation obtains. Heat-transfer rate is based on the difference between saturation and metal-surface temperatures. Surface between the steam and condensate film is at saturation temperature.

With saturated steam the metal temperature must be below saturation temperature to permit heat flow from condensate film to metal. Any metal at a temperature below saturation and in contact with superheated steam is also covered with a condensate film whose temperature therefore measures heat transfer to the metal. With metal-surface temperature above saturation there would be no heat transfer from saturated steam to the metal, and the heat-flow rate per degree difference between metal and superheated steam would be quite low. In condensing heaters metal temperature is always below saturation. With super-

(*Continued on page* 148)





*Installing Anaconda Condenser Tubes of Ambraloy 927 in condenser at The Westport Station of Consolidated Gas Electric Light and Power Co. of Baltimore. Tubes are 18 feet long, 1 inch O.D., .049 inch wall.*

# *Coolant*—Harbor-Polluted Water

# *Tubes*—ANACONDA AMBRALOY 927

THIS CONDENSER at the Westport Station of Consolidated Gas Electric Light and Power Co. of Baltimore, has 28,950 square feet of condensing surface, provided by 6,250 tubes 18 feet long. Tube life is accordingly a major factor in economy of operation.

The water available for cooling is a combination of fresh and salt water, combined with harbor pollution. Under similar conditions in other seaboard power plants, Anaconda Ambraloy 927 (Arsenical Aluminum Brass) has proved superior to other alloys. Hence the use of this type of tube in the condenser illustrated.

A pioneer in the development of condenser tube materials, The American Brass Company now produces 11 standard and several special alloys of this type. Assistance in selecting the one best suited to meet a specific set of conditions is offered by our Technical Department.

For detailed information on Anaconda Condenser Tubes, write for Publication B-2. 46173

ANACONDA
from mine to consumer

*Anaconda*
**CONDENSER TUBES**

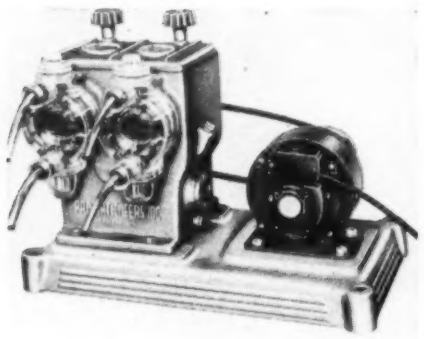
**THE AMERICAN BRASS COMPANY**
General Offices: Waterbury 88, Connecticut
*Subsidiary of Anaconda Copper Mining Company*
*In Canada:* ANACONDA AMERICAN BRASS LTD.,
*New Toronto, Ont.*

# WHAT'S New IN PLANT EQUIPMENT

## Proportioning Pump

DUPLEX DELUXE CHEM-O-FEEDER, a new diaphragm proportioning pump, delivers chemical reagents in an almost continuous stream. For positive injection of one or two chemicals at predetermined and adjustable rates, it is adapted for many applications, including feeding chemicals for water sterilization. Feeding rate of each chemical is individually adjustable for coarse variations by changing stroke rate through a 2-step cone pulley and belt arrangement.

For fine variations, a stroke-length adjustment knob on top of Chem-O-Feeder instantly varies amount of solution fed per stroke. Transparent plastic reagent heads bare vital operating parts, such as diaphragms and check valves, to visual observation by operator while equipment is in operation. Also, each discharge stroke of feeder is visible in sight-feeder domes and any feeding irregularity may be detected. Moving parts inside unit case operate in an oil bath. **Dept P, Proportioneers, Inc, 16 Codding St, Providence, R. I.**



## Fuse Link

BALANCED-LAG LINK puts extra lag in the low-overload working range to avoid unnecessary "blowing" and work stoppage. At same time positive protection is provided against damage to equipment from high-current surges because of shorts or grounds. Three or more "blow points" are designed into the balanced-lag links according to size. The center "blow point" is placed to carry the current of sustained overloads and "blow" only if gradually increasing overload becomes dangerous. The narrow "blow points" at the ends are not effected by these low overloads, but can be depended on to "blow" if shorts or grounds cause surges of current that endanger the equipment.

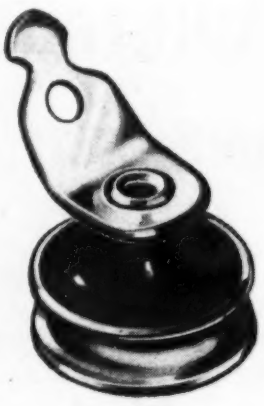
Ventilated case of fuse makes afterblow impossible and rigid alignment of arch-bridge construction is said to provide long fuse life and easy link replacement. **Dept P, Pierce Renewable Fuses, 117 Pacific Ave, Buffalo, N. Y.**

## Hermetic Terminal

NEW DEVELOPMENT in glass-to-metal hermetic terminals is known as the No. 110-*RHTL Fusite* terminal. It is a single terminal equipped with a hollow tube and copper connecting lug.

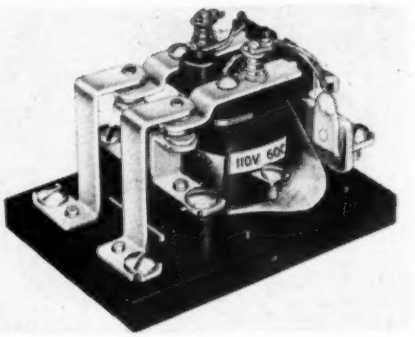
Outstanding features are said to be: (1) A high conductive lead can be brought directly through tube to copper connecting lug. (2) Terminal provides maximum internal clearance. (3) Outside connections are made with ease and rapidity. Semi-skilled help can make manual connections by placing wire through hole or wrapping it around double notch in connecting lug. (4) Necessity of interior connections is eliminated.

No. 110-*RHTL Fusite* terminal has been especially designed for capacitor field. From early indications, however, it will be used in many other electrical applications. User of *Fusite* hermetic terminals will receive *HermetiCan* as a container with terminals installed in the lid if he wants advantages of "heatless hermetic sealing." It can be hermetically sealed without heat or solder. **Dept P, Cincinnati Electric Products Co, 5324 Carthage, Cincinnati, O.**



## Flowmeter

INSTRUMENT, known as bellows-differential flowmeter, will be manufactured as a mechanical flowmeter, as an electric flowmeter and as a pneumatic-transmission flowmeter in a complete line of recording, indicating, integrating and automatic-controlling models. Meter body requires no mercury, as it operates on a new principle. A unique method of transmitting bellows motion to the pen arm completely isolates meter-body shaft from measured fluid. **Dept P, Bristol Co, Waterbury 91, Conn.**




## Power Relay

TYPE PR-8 double-pole double-throw power relay is for such power circuits as motor starting and heater loads up to 15 amp or any control circuit requiring fast, positive switching. Metal parts are heavily plated for resistance to corrosion. Insulation is molded or laminated bakelite. Coils are layer wound on insulating bobbins and baked varnish impregnated.

Full-floating contact carriers are positively locked in place, according to maker, and permit heavy contact pressure without chatter. To prevent hum, ac models are adequately copper shaded. A heavy return spring provides snap action and coil operates on only 4-v amp, or about 3 watts, so it is ideal for thermostats or other devices with delicate contacts. Coils will not heat on continuous duty. Fine silver contact point, $\frac{1}{8}$ in. dia, is rated at 15 amp non-inductive load at 110-v ac.

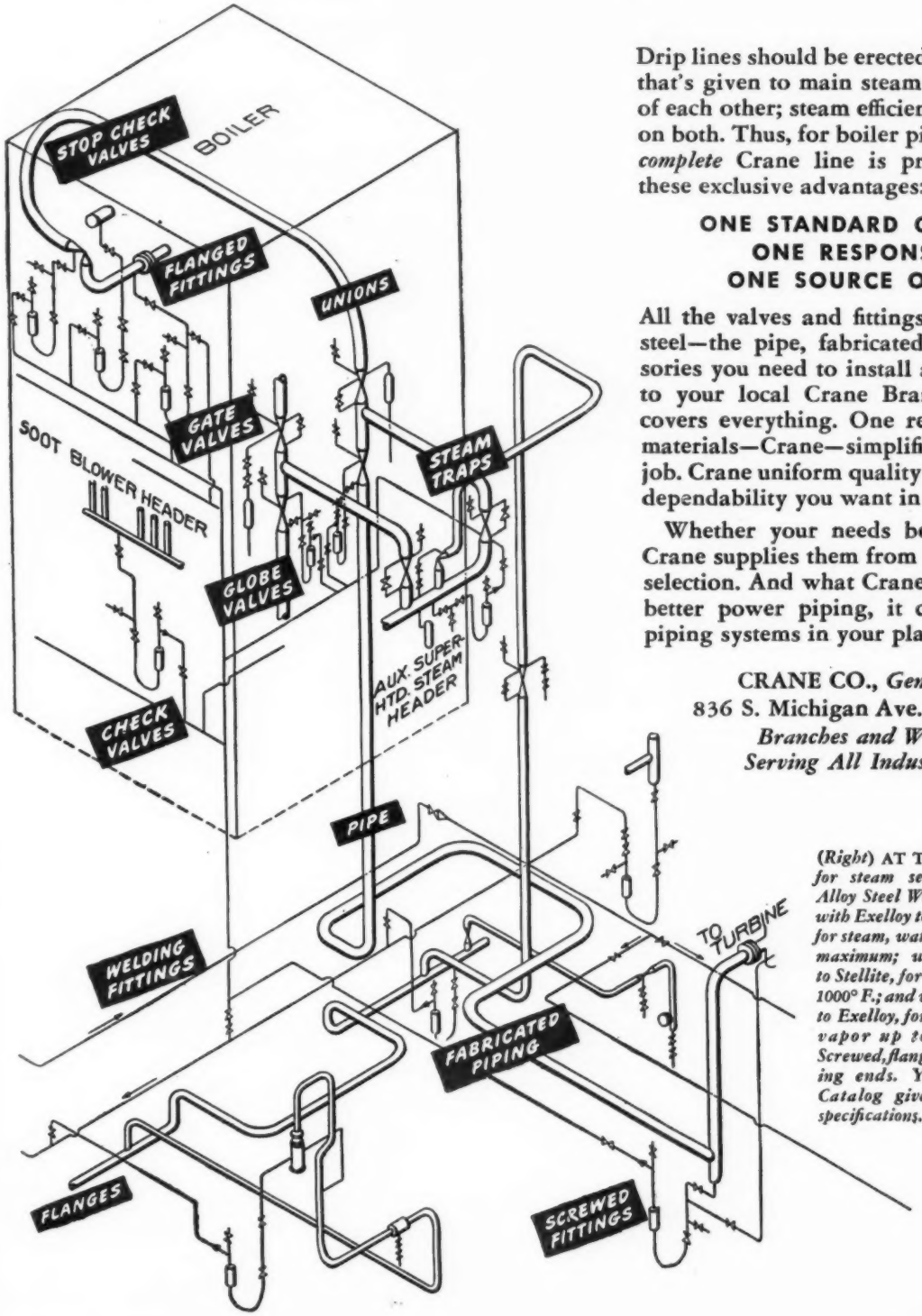
This is eighth in a series of power relays with standard coil voltages—6, 12, 24, 110, 220 v, 50-60 cycles ac; 6-, 12-, 24-, 110-v dc. **Dept 221, Potter & Brumfield Sales Co, 549 W Washington Blvd, Chicago 6, Ill.**

## Automatic Valve

PRIMARY FUNCTION OF AIR-LOK is to close automatically the line in which it is installed as soon as withdrawal of liquid is completed and before any air or vapor is pumped into system. By installation of these automatic valves there is said to be less likelihood of pumping equipment becoming damaged by racing under a no-load condition. By effect-

**POWER** brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P

# All Drip and Drain Piping
# . . . from the Complete Crane Line




Drip lines should be erected with the same care that's given to main steam lines. They're part of each other; steam efficiency depends equally on both. Thus, for boiler piping especially, the *complete* Crane line is preferred because of these exclusive advantages:

**ONE STANDARD OF QUALITY**
**ONE RESPONSIBILITY**
**ONE SOURCE OF SUPPLY**

All the valves and fittings, in brass, iron, or steel—the pipe, fabricated piping and accessories you need to install a boiler—one order to your local Crane Branch or Wholesaler covers everything. One responsibility for all materials—Crane—simplifies and speeds the job. Crane uniform quality assures the uniform dependability you want in all boiler lines.

Whether your needs be usual or unusual, Crane supplies them from the world's greatest selection. And what Crane can do to give you better power piping, it can also do for all piping systems in your plant.

CRANE CO., *General Offices:*
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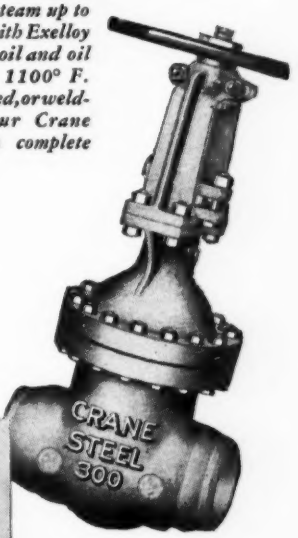
*Serving All Industrial Areas*

(*Right*) AT THE HEAD OF THE CLASS *for steam services — Crane 300-pound Alloy Steel Wedge Gate Valves. Supplied with Exelloy to No. 49 Nickel Alloy seating for steam, water, gas or air up to 850° F. maximum; with Stellite to Stellite, for steam up to 1000° F.; and with Exelloy to Exelloy, for oil and oil vapor up to 1100° F. Screwed, flanged, or welding ends. Your Crane Catalog gives complete specifications.*




EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

# CRANE

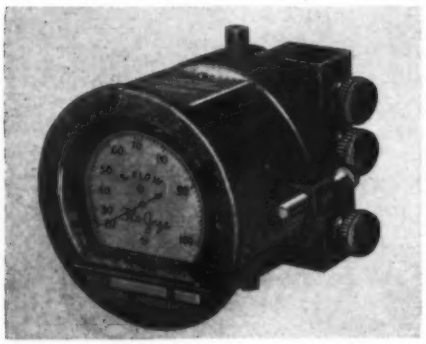
FOR EVERY PIPING SYSTEM

ing a tight shutoff in the line, it becomes practicable to install a vacuum switch in line near pump, which will stop an electric or gasoline pumping engine soon after valve closes.

At present, *Air-Lok* is offered in two sizes with flanged connections for 3- or 4-in. lines. Body is made up of semisteel castings and interior trim is corrosion-resistant nickel iron. Present design is for pressures up to 150 psi and for temperatures up to 250 F. **Dept P, Davis Regulator Co, 2540 S Washtenaw, Chicago, Ill.**

## Quintuplex Pump

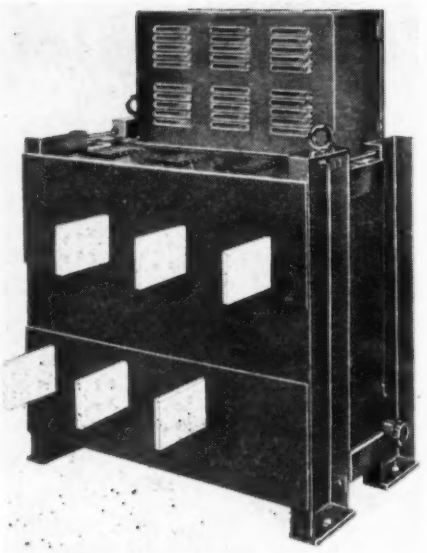
A 6-IN.-STROKE inverted quintuplex pump is rated at 300 to 450 hp, depending upon its speed. Plunger diameters range from 2 to 5¼ in., working pressures from 700 to 5000 psi and capacities from 60 to 850 gpm. **Dept P, Aldrich Pump Co, 3 Pine Street, Allentown, Pa.**



## Flow Indicator

FLO-GAGE FOR WATER, steam and air promotes efficient utilization of consumed liquids or gases, or both, particularly by elimination of wasteful excess. This midget differential meter indicates flow rate of liquids and gases through lines containing orifices, venturi tubes and insert nozzles as differential producers and also indicates liquid level and pressure differences. It is said to be particularly useful as an operating guide in manually adjusting valve positions at the start of a cycle of operations as well as in providing continuous information on flow rates so efficient operation may be maintained throughout complete cycle.

It requires little space, is easy to install and needs no mercury or auxiliary power. Gage has no stuffing box. It can be furnished to measure such units as gpm, cu ft per hr, etc. Gage mechanism is inclosed in a heavy semisteel chamber having a thick prestressed glass window designed for an operating pressure of 500 psi. **Dept P, Builders-Providence, Inc, 14 Codding St, Providence, R. I.**



## Heavy-Current Transformers

IMPROVED LINE of transformers from 5 to 500 kva is suitable for resistance heating and welding, rectifiers, electric furnaces and other applications where heavy current is required. Innovations include a built-in switch with safety interlock for changing secondary voltages, new scientific method of ventilation resulting in lower operating temperatures, protection of vital parts against corrosive, dust-laden atmosphere, heavy current windings laminated and transposed to reduce eddy-current losses, heatproof insulation such as fiber-glass, mica, asbestos, etc.

Transformers are for any line voltage and frequency; also 3-phase primary, 3-phase secondary; 3-phase primary, 2-phase secondary; and single phase. Photo is of a 90-kva transformer with 3-phase 6-wire output. **Dept P, Marcus Transformer Co, 32 Montgomery St, Hillside 5, N. J.**

## Immersion Pyrometer

INSTRUMENT DESIGN includes a large 4¾-in. indicator with a 4-in. direct-reading scale calibrated from 0 to 1500 F, or 0 to 2500 F, or equivalent C. Two models with over-all lengths of 27 and 43 in. are manufactured, both having a special swivel 8 in. from connector block that permits use of pyrometer at any angle. Swivel is equipped with toothed notches preventing it from becoming loose during operation. This new instrument can serve with "bare metal" and "protected" thermocouples, both being instantly interchangeable.

Thermoelectric system contains a permanent-magnet low-resistance galvanometer and an internal automatic cold-end compensator, in addition to an external adjusting screw. It is inclosed in a shock-, moisture- and dustproof steel case. **Dept P, Pyrometer Instrument Co, 103 Lafayette St, New York 13, N. Y.**

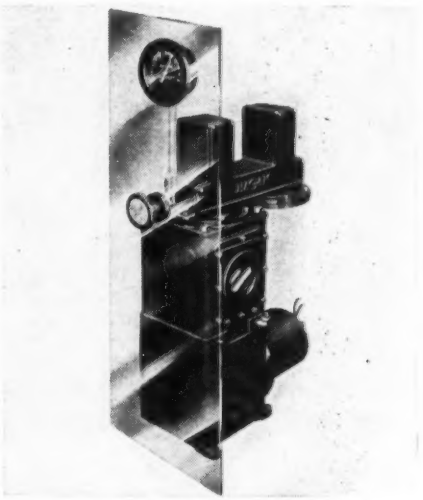
## Stainless Steel Electrodes

STAINWELD A 7 AND STAINWELD A 7-Cb are two electrodes for shielded arc-welding of stainless steels. They are made for welding steels of the 18% chromium and 8% nickel type in all positions.

*Stainweld A 7*, which was discontinued during the war, has been improved. It is for stainless steels designated by American Iron and Steel Institute as numbers 304 and 308. Said to produce an extremely smooth and steady arc with easy slag removal, it is for operation on dc or the higher-voltage ac welding units. It is in $\frac{1}{16}$-, $\frac{5}{64}$-, and $\frac{3}{32}$-in. sizes, 18-in. lengths, center grip; and $\frac{1}{8}$-, $\frac{5}{32}$- and $\frac{3}{16}$-in. sizes, 14-in. lengths, end grip.

*Stainweld A 7-Cb* is columbium stabilized and has operating characteristics similar to *Stainweld A 7*. This electrode is for stabilized 18-8 stainless steels designated by American Iron and Steel Institute numbers 321 and 347. This new electrode is in $\frac{3}{32}$-in. size, 18-in. length, center grip; and $\frac{1}{8}$-, $\frac{5}{32}$- and $\frac{3}{16}$-in. sizes, 14-in. lengths, end grip.

Both *A 7* and *A 7-Cb* shielded arc electrodes are also recommended for weld surfacing where an *austenitic* (work hardening) surface of medium hardness and good corrosion resistance is required. **Dept P, Lincoln Electric Co, Cleveland, O.**



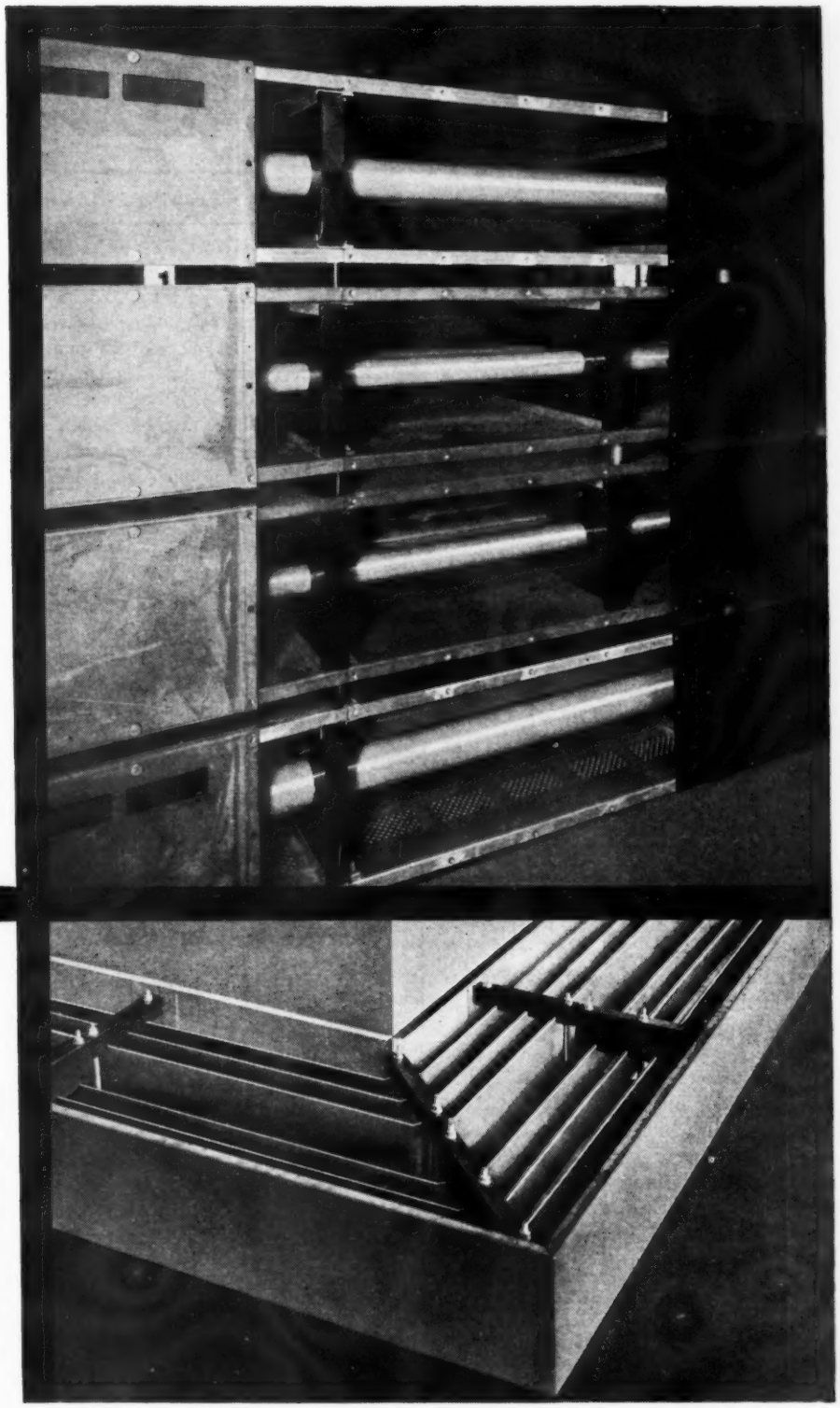
## Pressure Regulator

TYPE 2-SO REGULATOR regulates ratio of pressures or differential pressures. Among construction features of this device, according to maker, are its wide operating range (from 0.10 in. water column to 5 psi) its spinning pilot valve, positive action, adjustable response and rugged simplicity. This regulator is principally for control of: (1) suction, pressure or flow ratio in any gas- or air-flow system where accurate control is required (2) fuel-air ratio in a wide variety of indus-

(*Continued on page* 168)

**POWER** brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P

# REVERE really knows BUS BAR



WHEN copper became a vital war metal because such large quantities of it were needed for ammunition and other top priority uses, Revere was asked if it could make bus bars out of pure silver. We said "YES!" even though processing of silver for such a purpose had never been attempted. By the end of the war, Revere had produced 36,000,000 pounds of silver bus for aluminum and magnesium plants.

Today, copper bus bar by Revere is back, in all the usual forms, rectangular, round, square, etc. When planning or remodeling an electrical installation, ask Revere to quote on your bus requirements. Other Revere products of interest to those generating or using electricity are condenser tubes and plates, specially-prepared switch copper, copper and brass pipe and tube, commutator bars.

**REVERE**

**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*

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*Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.*

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# POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

FOREIGN FIELDS • MODERNIZATION POINTERS • CONVENTIONS

## ASME Section Discusses Boiler Chemical Cleaning

► INTERESTING DEVELOPMENTS and experiences in cleaning boilers and heat exchangers chemically were presented on Mar 6 at Newark meeting of New Jersey section, metropolitan div of ASME. E J Billings, executive assistant, Babcock & Wilcox Co, arranged the program and F W Fox, staff engineer, Standard Oil Development Co, served as meeting chairman. Preliminary feature was a slide lecture presented by Dowell Co during a dinner that preceded the meeting.

Speakers were: D C Carmichael, E I du Pont de Nemours & Co; F H Eberle, Standard Oil Development Co; J J Mack Jr, Tidewater Associated Oil Co; W L Mann, National Lead Co; S W Shepard, Calco Chemical Div, American Cyanamid Co; L A Winkelman, Public Service Elec & Gas Co of N. J.

Importance of cleaning-solution temperature was stressed because some inhibitors tend to break down above 160 F and acid attack on base metal is greatly accelerated above 50 F.

### *Acid Concentration*

Acid concentrations on different jobs varied considerably, with 2 to 10% of inhibited hydrochloric acid. General practice is to use about a 5% solution. On one job a solution of 12% sulphuric and 5% hydrochloric with inhibitor was successful in cleaning a fresh-water heat exchanger. Efficiency of unit was increased from 40% to normal after a 24-hr cleaning period.

One speaker pointed out importance of giving equipment a hydrostatic test after each cleaning to detect leaks formerly sealed by adhering scale. This suggestion was prompted by the fact that scale removal uncovered numerous pinhole leaks in an old heat exchanger.

Preferences for cleaning method differed. Although acid can be added constantly to refortify solvent another practice drains some of the spent solution and adds new water and acid as makeup. Second method offers advantage of flushing sediment away rather than recirculating it through the unit.

Chemical cleaning may or may not damage gaskets and packing. To be on the safe side they should be replaced after flushing. Also, circulating pumps handling acid solution should not be run against a closed discharge because overheating accelerates attack on pump.

Neutralizing solutions include caustic soda for steel and sodium carbonate for Admiralty metal. One speaker recommended trisodium phosphate instead of caustic soda for steel because he found it prevented immediate rusting.

Another speaker told how he cleaned heat exchangers, using once-through cooling water, by feeding solvent into cooling water while unit was in service. Sufficient scale was removed to raise the heat transfer considerably, and yet service to process was not interrupted.

## Foreign Loans Granted For Electrical Equipment

Loans totaling $24,350,000 for purchase of U. S. electrical equipment have been granted four Latin American governments or companies, the Export-Import Bank reported to Congress recently.

Largest of these loans was a $20,000,000 credit to Mexico "to assist in financing purchase in the U. S. of equipment, materials and services to be used in connection with a broad electrification program in Mexico." The program is to be carried out by the Comision Federal de Electricidad, which is an agency

(*Continued on page* 184)

## PLAN EXPERIMENTAL ATOMIC POWER PLANT

**A pilot-size atomic plant to make controlled heat for generation of electric power will be erected at Oak Ridge, Tenn., with construction of the heat-producing pile expected to begin this year.**

**Intended as a demonstration unit, rather than a commercially practical one, design will be based on fundamental research carried out mostly at the Metallurgical Laboratory of the University of Chicago. In honor of the director of that work, Dr Farrington Daniels, the unit is to be known as the "Daniels' Pile."**

**Manhattan Engineer District has completed management contracts with a group of technical institutions and industrial firms. The project has been assigned to a technical foundation of the Metallurgical Laboratory, University of Chicago. Monsanto Chemical Co will have over-all authority and responsibility for design, construction and operation of the atomic plant and has assigned Dr Charles A Thomas, vice-president and technical director, to the job. Also participating will be Allis-Chalmers, General Electric, Westinghouse, and Army, Air Force and Navy personnel.**

**"The first atomic power plant will involve the design, construction and operation of a chain-reaction pile together with auxiliary equipment," Maj Gen Leslie R Groves, head of Manhattan District, said in announcing the project. "Primary consideration is the need to reduce to practice some of the many ideas for power piles developed as an outgrowth of the atomic-bomb program.**

**"When the pile is ready to operate, possibly some time late this year or early next year, radioactive fuel will be introduced into the pile structure under controlled conditions and a chain reaction will get under way. Mass will be converted into heat energy and finally the mechanical energy will be converted into electrical energy.**

**"In evaluating prospects held by the proposed experimental atomic-energy power plant, it is important to remember that a great amount of work remains to be done before fissionable material can be brought within the range of economic usability. This is to be a pilot plant; in other words, a research tool from which knowledge will be derived for subsequent development."**

**most slimes and algae are like**

*Fingerprints*

*...says*

T. M. James Jr.

**Nalco Representative**
**The Flox Company,**
**Minneapolis, Minnesota**

***A 900X magnification of one of the troublesome slimes brought under control by means of Nalco Laboratory research.***

OUT of a few major forms of slime and algae come variations that make most of them as individually different as fingerprints. And the fingerprint slimes and algae react in a multitude of ways toward control treatments . . . One tough slime grew and thrived on a treatment compound that was quick death to closely similar forms! Nalco research found the proper treatment for that slime; and the Nalco Laboratories are available today to solve your particular slime or algae control problem. For year around freedom from water treatment headaches, call your Nalco Representative, or write direct.

**NATIONAL ALUMINATE CORPORATION**
**6222 West 66th Place, Chicago 38, Illinois**

*Canadian inquiries should be addressed to*
Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ont.

*Nalco*

THE SCIENTIFIC WATER TREATMENT FOR ALL INDUSTRY

*How to plan a*

# DIESEL ENGINE STARTING AIR SYSTEM

**Another in the series of basic Piping Layouts prepared by Jenkins Bros.**

**For starting Diesel Engines** of over 150 horsepower rating, the most dependable and widely used method is an air system of the type illustrated in this layout. With this starting system hooked up to Diesel installations generating power and heat for such buildings as factories, hotels, large apartment houses, and stores, interruptions such as might occur through failure of electric supply or storage cells are avoided.

**A conventional type system** is shown, with a duplex drive air compressor, the electric motor drive, and the emergency gasoline engine drive. In some systems, automatic shutdown of the electric power and automatic starting is provided, responsive to a set air pressure, while in others all operations are manually controlled. Piping is identical for both types.

**Safety valves** are provided for the compressor and the air storage tanks. Check valves are installed on the air storage tank feed lines and the compressor discharge lines to prevent accidental discharge of the tanks.

**Piping is arranged** so that the compressor will either fill the storage tanks and/or pump directly to the engines. Any of the three storage tanks may be used for starting, and pressure gauges indicate their readiness. The engines are fitted with quick opening valves to admit air quickly at full pressure and shut it off at the instant rotation is obtained. A bronze globe valve with a renewable composition disc for air service is installed ahead of each quick-opening valve to permit complete shutdown of the engine for repairs, maintenance of the all-important quick-opening valve, and regulation of the flow of air. Drains are provided at low points to remove condensate from the air storage tanks, lines, and engine feeds.

**Globe valves** are recommended throughout this hookup except on the main shut-off lines where gate valves are used because of infrequent operation. The quick-opening valves should be mounted in a vertical position, with the lever down, so that a slight pull will admit sufficient air to turn over the engine.

**Several types and pressure ranges** of Jenkins Valves, other than those shown, can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installation.

**Copies of Layout No. 10** will be furnished on request . . . also copies of future Piping Layouts. Just fill out and mail the coupon.

## A CHOICE OF OVER 600 JENKINS VALVES

To save time, to simplify planning, to get the advantage of Jenkins specialized valve-engineering experience, – select all the valves you need from the Jenkins line, fully described in the Jenkins Catalog. It's your best assurance of the *lowest cost in the long run.*

Jenkins Bros., 80 White Street, New York 13; Bridgeport; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London, England.

## Jenkins PRACTICAL PIPING LAYOUTS

**Illustrating the proved 3-point formula for trouble-free, time-defying hookups**

1. **Use the right type valve for the service.**
2. **Place valves correctly in the line.**
3. **Choose Jenkins Valves for lifetime economy.**

**10**

**Fig. 713**
**Quick Opening Bronze Globe Valve**

Has a catch-open lever. Opens with a quick pull – stays open till closed with a light push. For air service, this valve should be fitted with Jenkins Renewable Composition Disc No. 936-A.

# JENKINS VALVES

**LOOK FOR THE DIAMOND MARK**
*SINCE 1864*

TRADE JENKINS MARK

**125 TO 600 LBS. PRESSURE**

Jenkins Bros

BRONZE ★ IRON ★ STEEL

FOR EVERY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING-HEATING SERVICE
SOLD THROUGH RELIABLE INDUSTRIAL DISTRIBUTORS EVERYWHERE


# DIESEL ENGINE STARTING AIR SYSTEM

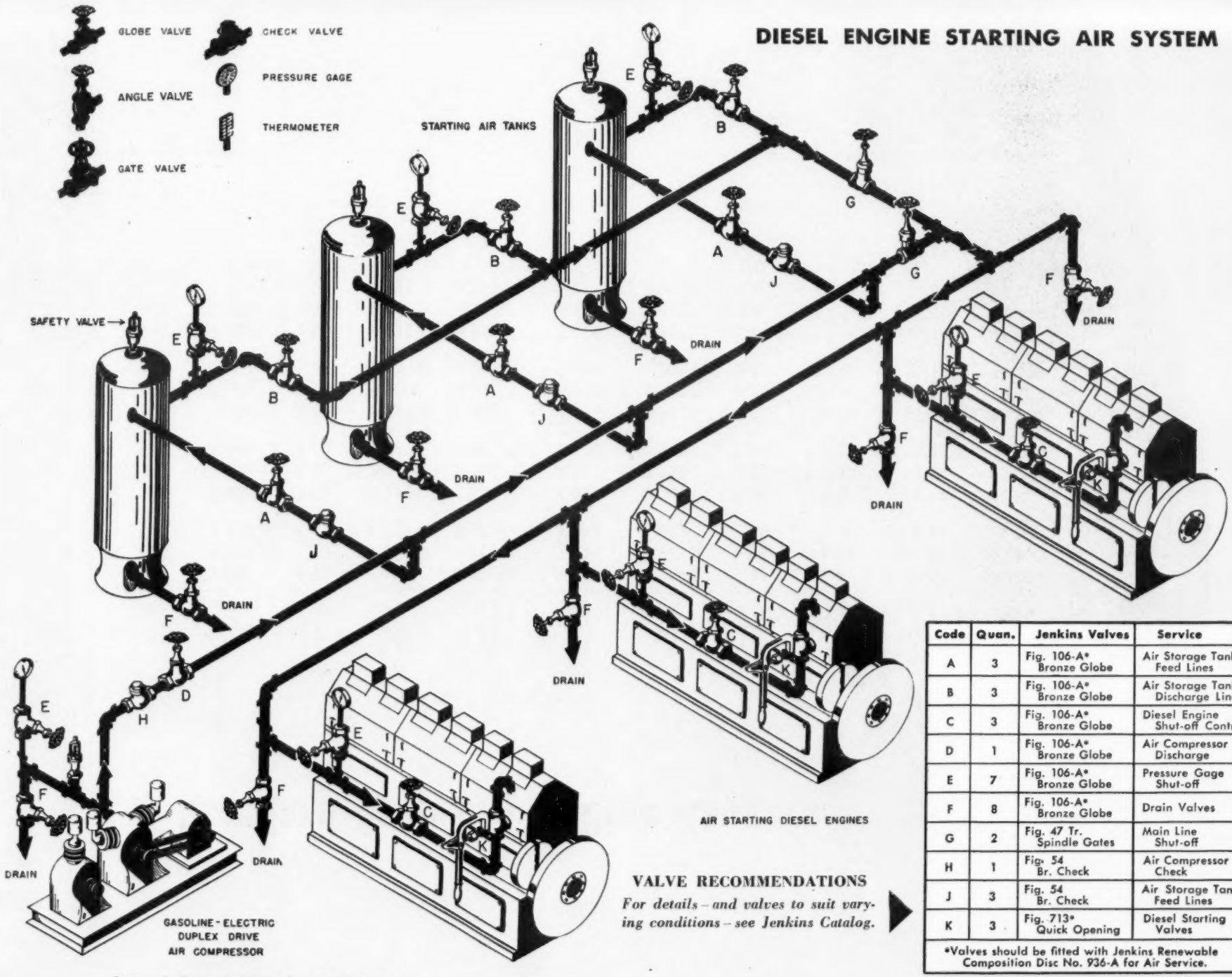


*Diagram by Huxley Madeheim, Consulting Engineer*

| Code | Quan. | Jenkins Valves | Service |
|---|---|---|---|
| A | 3 | Fig. 106-A* Bronze Globe | Air Storage Tank Feed Lines |
| B | 3 | Fig. 106-A* Bronze Globe | Air Storage Tank Discharge Lines |
| C | 3 | Fig. 106-A* Bronze Globe | Diesel Engine Shut-off Control |
| D | 1 | Fig. 106-A* Bronze Globe | Air Compressor Discharge |
| E | 7 | Fig. 106-A* Bronze Globe | Pressure Gage Shut-off |
| F | 8 | Fig. 106-A* Bronze Globe | Drain Valves |
| G | 2 | Fig. 47 Tr. Spindle Gates | Main Line Shut-off |
| H | 1 | Fig. 54 Br. Check | Air Compressor Check |
| J | 3 | Fig. 54 Br. Check | Air Storage Tank Feed Lines |
| K | 3 | Fig. 713* Quick Opening | Diesel Starting Valves |

*Valves should be fitted with Jenkins Renewable Composition Disc No. 936-A for Air Service.

## VALVE RECOMMENDATIONS

*For details – and valves to suit varying conditions – see Jenkins Catalog.*

JENKINS BROS., 80 White St., New York 13, N. Y.

Please send me a reprint of Piping Layout No. 10 and future Layouts as they become available.

*Name* .....

*Company* .....

*Address* .....

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# Standard Springs For Pipe Hangers

| Working load, lb | Inches compression, per 1000 lb | Spring scale, lb per in. deflection | Maximum deflection allowed, in. | Coil | | | | Wire diameter, in. | Number of active coils | Solid height, in. | Free height, in. | Maximum fiber stress at full working load, lb per sq in. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Outside diameter, in. | Mean diameter, in. | Mean radius, in. | Inside diameter, in. | | | | | |
| 500 | 7.00 | 143 | 3.500 | 4.50 | 4.0000 | 2.00000 | 3.500 | 0.5000 | 9.83 | 5.47 | 12.47 | 40,800 |
| 625 | 5.00 | 200 | 3.125 | 5.00 | 4.4375 | 2.21875 | 3.875 | 0.5625 | 8.28 | 5.27 | 11.52 | 39,600 |
| 750 | 4.50 | 222 | 3.375 | 5.75 | 5.125 | 2.5625 | 4.500 | 0.625 | 7.38 | 5.30 | 12.05 | 40,000 |
| 1000 | 3.50 | 286 | 3.500 | 6.00 | 5.3125 | 2.656 | 4.625 | 0.6875 | 7.50 | 5.91 | 12.91 | 41,800 |
| 1250 | 2.50 | 400 | 3.125 | 6.25 | 5.5000 | 2.750 | 4.750 | 0.750 | 6.83 | 5.95 | 12.20 | 41,500 |
| 1500 | 2.25 | 444 | 3.375 | 6.50 | 5.6875 | 2.84375 | 4.875 | 0.8125 | 7.66 | 7.12 | 13.87 | 40,600 |
| 2000 | 1.75 | 571 | 3.500 | 6.75 | 5.8125 | 2.906 | 4.875 | 0.9375 | 9.85 | 10.28 | 17.28 | 36,250 |
| 2500 | 1.25 | 800 | 3.125 | 7.00 | 6.0000 | 3.000 | 5.000 | 1.0000 | 8.3 | 9.40 | 15.65 | 38,300 |
| 3000 | 1.125 | 889 | 3.375 | 7.25 | 6.1875 | 3.0938 | 5.125 | 1.0625 | 8.71 | 10.43 | 17.18 | 39,400 |
| 4000 | 0.875 | 1142 | 3.500 | 7.50 | 6.3125 | 3.156 | 5.125 | 1.1875 | 10.0 | 13.18 | 20.18 | 38,400 |
| 5000 | 0.625 | 1600 | 3.125 | 7.75 | 6.4375 | 3.2188 | 5.125 | 1.3125 | 10.0 | 14.57 | 20.82 | 36,400 |
| 6000 | 0.5625 | 1775 | 3.375 | 8.00 | 6.625 | 3.3125 | 5.25 | 1.3750 | 10.0 | 15.26 | 22.01 | 38,800 |

$$\text{Maximum fiber stress} = \frac{\text{load} \times 8 \times \text{coil mean diameter}}{3.1416 \times 3 \times \text{wire diameter}}$$

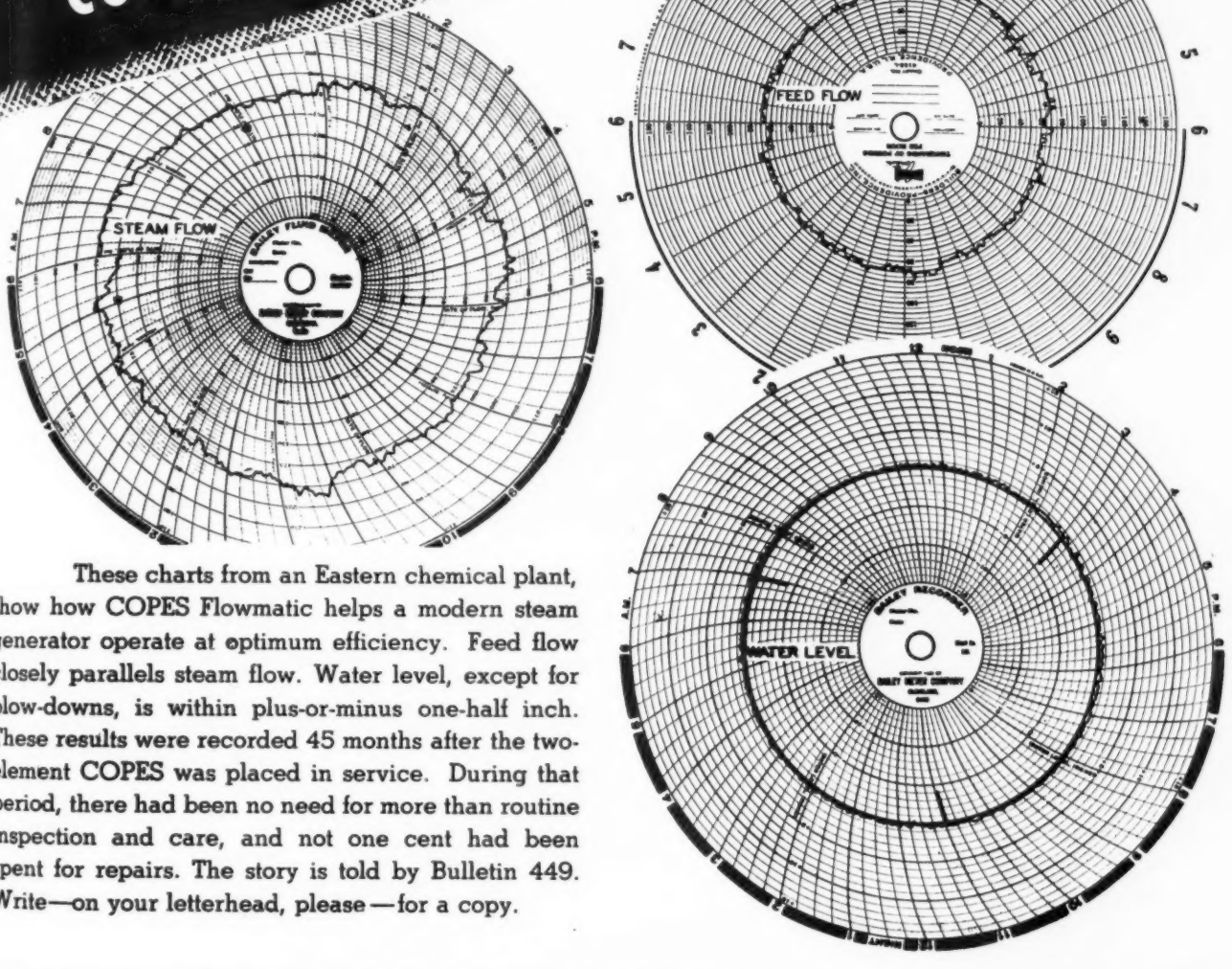
$$\text{Active coils} = \frac{\text{deflection} \times 11{,}500{,}000 \times 4 \times \text{wire diameter}}{64 \times \text{load} \times 3 \times \text{mean coil radius}}$$

Solid height = (active coils × wire diameter) + (1.1 × wire diameter)

Free height = solid height plus twice deflection

By L C Stang

# THE BOILER: Foster Wheeler Type S.A.
# DRUM LEVEL: Plus-or-Minus ½ inch
# CONTROL BY: COPES FLOWMATIC




These charts from an Eastern chemical plant, show how COPES Flowmatic helps a modern steam generator operate at optimum efficiency. Feed flow closely parallels steam flow. Water level, except for blow-downs, is within plus-or-minus one-half inch. These results were recorded 45 months after the two-element COPES was placed in service. During that period, there had been no need for more than routine inspection and care, and not one cent had been spent for repairs. The story is told by Bulletin 449. Write—on your letterhead, please—for a copy.

**NORTHERN EQUIPMENT COMPANY, 561 GROVE DRIVE, ERIE 6, PENNSYLVANIA**

*Feed Water Regulators, Pump Governors, Differential Valves,*
*Liquid Level Controls, Reducing Valves and Desuperheaters*

**BRANCH PLANTS: Canada, England, France.** ***Representatives Everywhere***

COPES — FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC ★ REGULATOR

# More-Expressive Engineers . . .

The engineer son of a friend of mine, who has gone to work for a large manufacturer of electrical equipment, came home the other night complaining he was being diverted from his first, true love—engineering. He said they got a bunch of the new young engineers together that morning, and gave them a talk that went something like this:

"We are going to give you training to make you better engineers, and we will start off with a course in public speaking." Loud groans from the audience.

"Then," said the leader of the program, "we're going to teach you how to write." More groans.

"Finally," continuing, "we're going to give you a basic course in selling."

"But," protested the group, "we don't have to sell. We're going to be engineers."

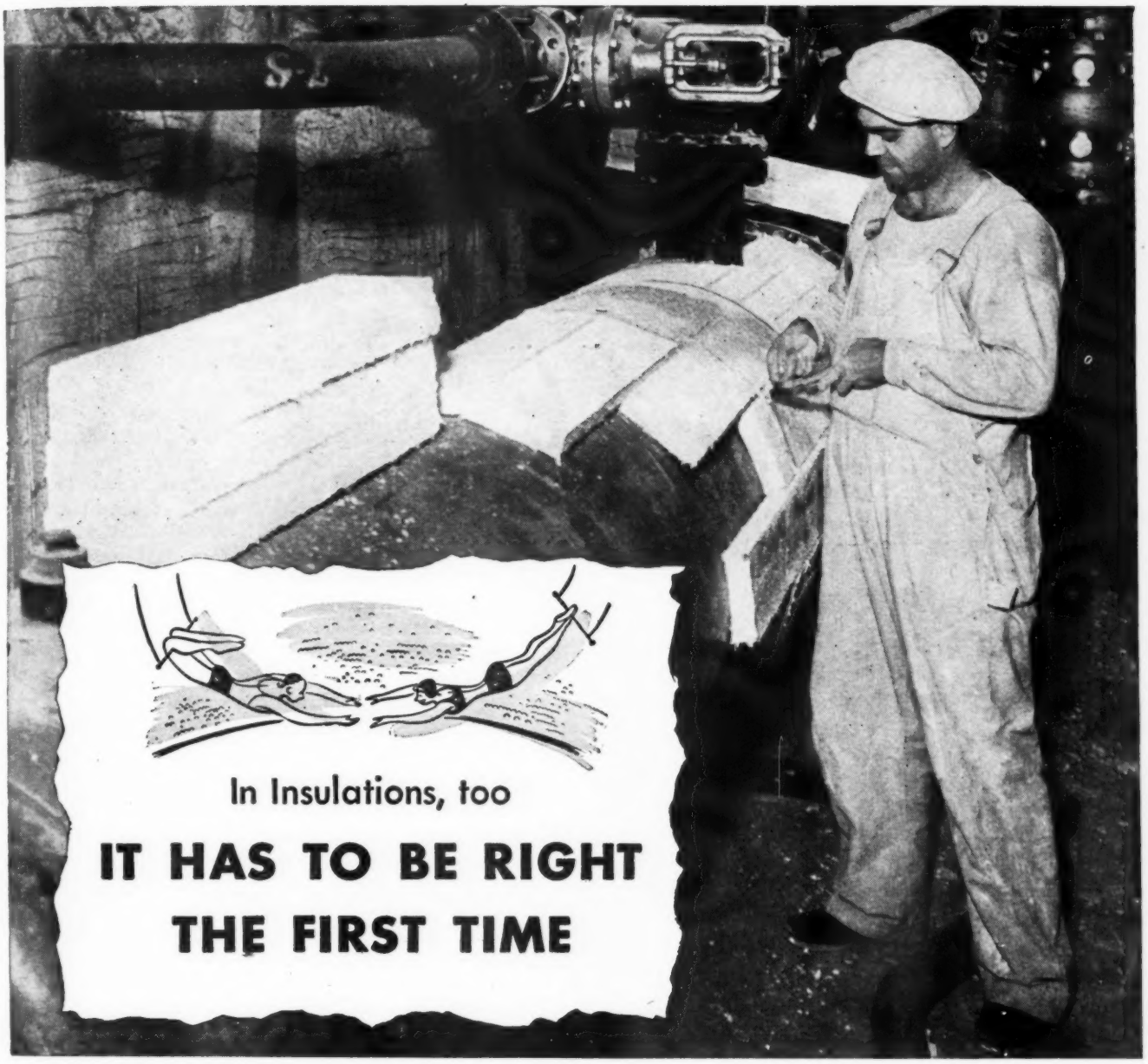
There's a thought there for all of us. True enough, we are all engineers, but we need education along other lines, too. As mechanically trained men, we possess the background for leadership—but what good is our knowledge if we can't put our thoughts across to our associates? Moreover, I've been in several plants where the power man has been a real expert—a chief respected for his engineering ability—but his boss in the front office didn't know it. And good ideas for plant improvement died in the engine room because they weren't put to management in understandable terms.

As Dean Kimball of Cornell used to say: "The average engineer can figure out most any kind of a problem and be pretty sure of the answer, except possibly where the decimal point is." In dealing with technical questions, most of us are entirely competent, but our training has usually been narrow—and that fact handicaps us in some of the broader aspects of our jobs.

There have been many crackpot schemes sold in this country by the spell of polished speakers and by the power of well-written words. Let us engineers put in some time getting the same kind of proficiency in order to promote constructive ideas. It will be a big help in making us not only more expressive—and hence better—engineers, but also more able to handle people under us and above us. Remember—the more our job becomes involved with the human elements rather than equipment, the broader become our problems, and the more we need to write and talk clearly and forcefully.

George Edwards

*Engineer*




## . . . that's why J-M 85% Magnesia is the standard for industry!

When it comes to insulations, "*nearly* right" is *wrong!*

That's why it pays to get J-M 85% Magnesia . . . most widely used of all industrial insulating materials for temperatures up to 600° F. Offering high insulating efficiency for years of service, J-M 85% Magnesia is light in weight . . . uniform in composition. Furnished in pipe covering form and in straight or curved blocks, it may be quickly applied to flat or rounded surfaces.

And to get complete insulating efficiency, it's good business in the selection of materials to rely on the professional judgment of Johns-Manville insulation engineers . . . specialists whose knowledge and skills are backed by 88 years of J-M experience and research.

Remembering that insulation will only render its maximum efficiency when properly applied, Johns-Manville offers an application service of skilled construction units. These units are organized to handle every detail of *your* insulation requirements—from plans to finished job.

You can get complete details, including answers to any specific questions you may have, from Johns-Manville, 22 East 40th Street, New York 16, N. Y.

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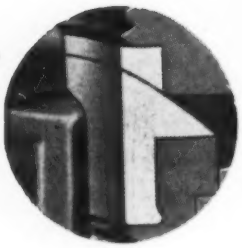
PRODUCTS

# JOHNS-MANVILLE *First in* INSULATIONS

# Have No Doubt About



**THE 2 BRONZE SEATS GROUND TO A TRUE BALL JOINT INSURE LONG WEAR**

The super-smooth seats in a Dart Union join without jamming; part without pounding. Besides, the body and nut—made of high-test air-refined malleable iron—are practically indestructible. For these reasons Darts may be used over and over again. And, naturally, they cost less in the long run. Your supplier will be glad to demonstrate Darts.

DART UNIONS

E. M. DART MFG. COMPANY, PROVIDENCE 5, R. I.


## Boiler Reduces Cost

(*Continued from page 67*)

through the economizer into the boiler. Primary feedwater treatment is pumped into the economizer and after-treatment goes into the boiler's steam drum.

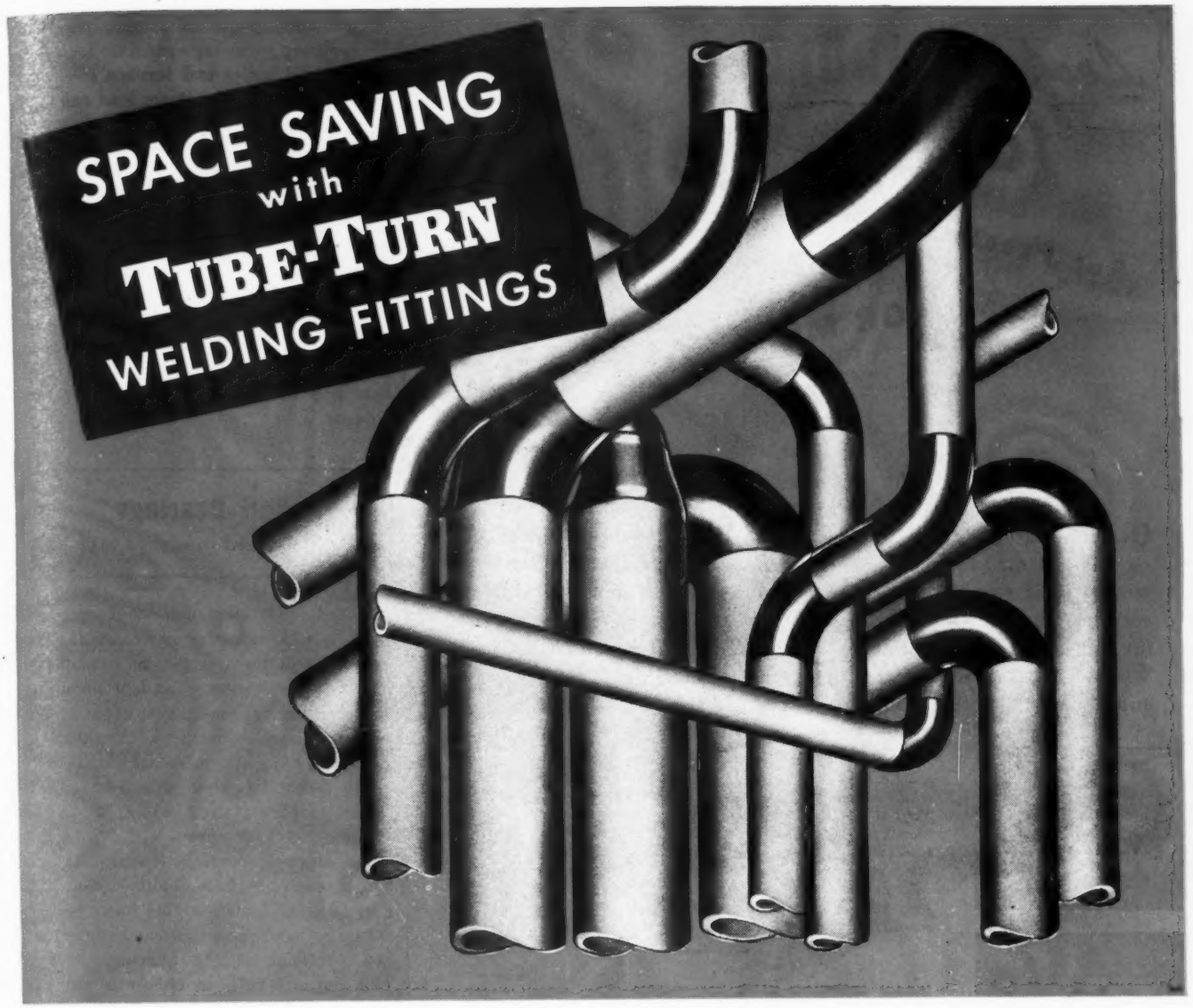
Boiler water, sampled each hour at the economizer and boiler mud drums, is checked by the company's chemists. Treatment is then controlled accordingly, by chemical-feed rate to the economizer and boiler and by adjusting the rate of continuous blowdown. A firm of feedwater chemists is employed to provide consulting service and recommend the water treatment.

All pushbuttons for the forced- and induced-draft-fan motor controls, the feed-pump motor control, the constant-speed stoker-drive motor, the speed-selector switch for the 4-speed stoker motor and the schedule adjuster for the stoker-extension-grate hydraulic dump are located on the boiler-meter panel, Fig 4. On this panel is a steam-flow air-flow meter, which also records steam temperature. Temperature of feedwater in and out of the economizer, and of flue gas in and out of the economizer, is recorded on another meter. A 5-point draft gage shows stoker windbox, extension-grate, overfire, economizer-exit and uptake drafts. A fourth meter records feedwater pressure and steam pressure and a fifth records feedwater level in the boiler drum and sounds an alarm if the level goes 3 in. below or above the drum's center line.

These meters give the boiler operator the necessary information to maintain test performance at all times. If it deviates, the meters provide a means of locating the cause. All coal is weighed to the stoker hopper by a weigh larry. From coal weight and steam-flow records, a check is made each shift of boiler and furnace performance.

When the new boiler was ready to go into service it was fired and boiled out for 48 hr. It was allowed to cool, then opened and thoroughly washed out and put into service. After two weeks' operation it was shut down over a weekend, and inspected by the insurance and government inspectors and the boiler and stoker company's engineers. After these inspections the boiler went back into service where it has remained ever since. For six days a week it operates continuously at 100,000 lb of steam per hour and during the remaining 24 hr it supplies the steam required for weekend service.

Even though acceptance tests have not




COMPACTNESS and flexibility are built into piping installations where pipe is joined with Tube-Turn welding fittings. Ceiling mounted pipe and streamlined expansion loops, for example, are constructed with only plain butt welds in nearly all cases. Tube-Turn elbows and returns can be cut to odd angle turns because of their uniform wall thickness.

Close-nested, permanently leakproof piping systems are further assured by the dimensional accuracy of Tube-Turn welding fittings. This accuracy permits installing *any* pipe line according to design without making allowances for variations in individual fittings. All Tube-Turn fittings of the same part number are identical in all dimensions. Whatever your fittings requirement, from one-half inch to 30 inches, choose quality-controlled Tube-Turn welding fittings for uniform wall thickness, smooth inner wall, close-knit grain structure, freedom from inherent strains.

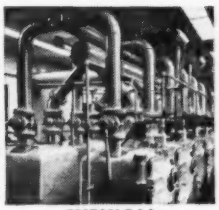
Consult your favorite piping authority and see your Tube Turns distributor. For more information on superior Tube-Turn welding fittings and pace-setting installations in many industries, write for Catalog 111.

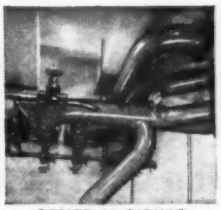
**Selected Tube Turns Distributors in every principal city are ready to serve you from their complete stocks.**

**TUBE TURNS (Inc.)** Louisville 1, Kentucky. Branch Offices: New York, Washington, D. C., Philadelphia, Pittsburgh, Cleveland, Detroit, Chicago, Houston, San Francisco, Seattle, Los Angeles.

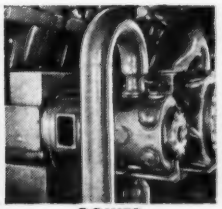
**TUBE-TURN** TRADE MARK tt *Welding Fittings and Flanges*

PETROLEUM


CHEMICAL


GENERAL PIPING

SHIPBUILDING

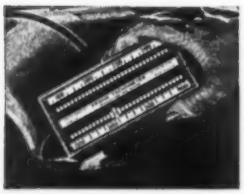

POWER

EQUIPMENT

# Look to BIDDLE . . .

## For Precision Instruments FOR MEASURING SPEED

**Over the past 30 years we have been a source of supply for precision speed measuring instruments that have consistently demonstrated their superior quality, high accuracy and dependability in service. We now offer a variety of types and ranges of instruments for measuring rotational and surface speeds, and rates of vibration. We believe they will be helpful in the solution of some of your engineering problems. The following are typical:**



**The FRAHM VIBRATING REED TACHOMETER** *requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine on which the instrument is held. For hand use in servicing, installation and maintenance work; also built in types for permanent mounting. Various ranges available from 900 up to 100,000 rpm. Used also and in the same way for measuring rates of vibration.*

*Write for descriptive Bulletin 1590-P.*

**JAGABI PRECISION HAND TACHOMETER.** *Five ranges in one instrument. Simply rotate the barrel head to change to any one of the five ranges—60-240, 200-800, 600-2400, 2000-8000, 6000-24000 rpm. Measures rpm and fpm by direct pointer deflection . . . fly-ball governor principle . . . large, easy-reading dial with two scales nearly 6½" long. . . . Accurate to within one scale division. . . . Independent of direction of rotation. . . . Supplied complete with case and accessories.*

*Write for descriptive Bulletin 1800-P.*

**JAGABI HAND TACHOSCOPE.** *A combined speed counter and stop watch with synchronized start and stop mechanism for measuring average speeds and constant rates of speed to a high degree of accuracy. Used for routine tests as well as for checking other speed-measuring instruments up to 20,000 rpm. Can be used also for measuring linear or peripheral speeds. Stop watch can be used independently. Supplied complete with case and accessories.*

*Write for descriptive Bulletin 1790-P.*

**The JAGABI SPEED INDICATOR** *is a watch size speed measuring device which adds up the number of revolutions over a period of three (or six) seconds and shows the revolutions per minute without any calculations. Can also be used to measure feet per minute. Available in two models—for low speeds up to 2000 rpm and for all speeds up to 20,000 rpm. Accuracy well within one-half of one per cent.*

**JAGABI HI-SPEED INDICATOR** *(not shown). Chronometric type designed for extraordinarily high speeds, operating on the same principle as the Jagabi Speed Indicator. For speeds up to 100,000 rpm.*

*Write for descriptive Bulletin 1505-P.*

**JAMES G. BIDDLE CO.** • **1316 ARCH STREET PHILADELPHIA 7, PA.**


been made, boiler and stoker performance during everyday operation indicates a combined boiler and furnace efficiency of about 86%. Total steam load can now be carried on the new boiler and two of the older stoker-fired boilers, with one as a spare. Steam costs have been reduced 20% because of the new boiler and stoker's high efficiency and not having to burn coal under the old refuse-fired boilers.

*In design and installation of the boiler-plant extension Hardy S Ferguson & Co served as consulting engineers in cooperation with A N Ball, chief engineer and Parker Larter, steam superintendent.*

## Ball Bearings

(*Continued from page* 98)

required, as for machine-tool spindles. Back-to-back mounting is needed if bearing floats in the housing to compensate for shaft expansion. Tandem mounting is needed for extreme thrust capacity and minimum axial movement. Applications include: (1) heavy radial loads (2) heavy thrust in either direction (3) extreme axial rigidity (4) great radial rigidity (5) high speed.

*Self-aligning bearing.* Inner ring has two raceways as in a double-row design, Fig. 10 and 11. Outer ring has a spherical inner surface so balls and inner race can pivot about the bearing's center. This permits balls to choose a path on outer race to compensate for misalignment between shaft and bearing housing. Bearing is made in two widths: Standard series has same width as a single-row design, while wide series has width of a double-row bearing. This type handles: (1) loads when shaft or housing may be out of line (2) moderate radial loads (3) light thrust loads (4) moderate speeds.

*Thrust bearings.* These designs, Fig. 18 and 19, are called washer thrust bearings. Races resemble flat washers and usually have a groove on one face for balls. This design handles heavy thrust loads in one direction only, and has no radial capacity. Do not use it at high speeds because centrifugal force causes unsatisfactory ball operation that leads to early bearing failure. Instead, use angular-contact bearing for thrust loads at high speeds. These designs are made with and without retainers, and some are self-aligning, Fig. 19. They may be used for: (1) maximum thrust in one direction (2) axial rigidity in one direction (3) moderate speeds.

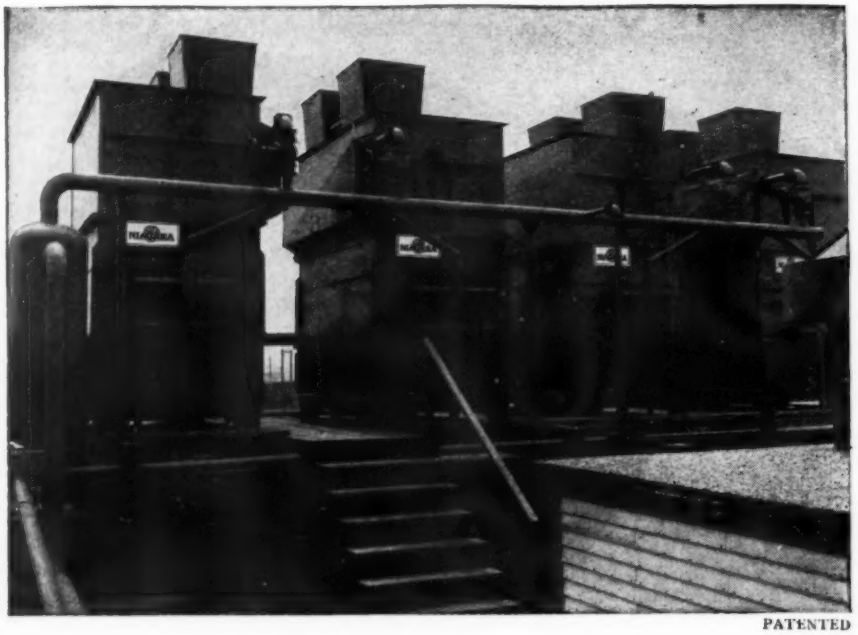
*Accessory bearings.* There are many

Balanced hinged-pin disc rides evenly in the flow when valve is open; closes quietly when the flow slows down. Hammering and consequent strains on pipe lines are eliminated. Head losses are reduced 65% to 80% of those experienced with conventional type check valves.

Installed on pump discharge lines, Chapman Tilting Disc Valves not only increase pipe line capacity but also effect substantial power savings.

Write for new bulletin.

**The CHAPMAN**
**VALVE MFG. COMPANY**
***Indian Orchard, Mass.***



PATENTED

# INCREASED PRODUCTION FOR REFRIGERATION USERS

● You Can Obtain Greater Refrigeration Capacity from your Present Compressor by using NIAGARA DUO-PASS AERO CONDENSER.

This is possible because you use outdoor air as the cooling medium with the extra benefit of evaporative condensing! Condensing temperatures are lowered; condenser capacity is increased; head pressures are reduced—additional compressor capacity is the result.

Only the patented NIAGARA Duo-Pass makes this gain permanent because no other evaporative condenser lowers condensing temperatures to the point where deposits do not accumulate on condenser tubes. This does away with loss of time for cleaning and assures always full capacity.

*Write for Bulletins 91 and 93.*

**NIAGARA BLOWER COMPANY**

*Over 30 Years of Service in Industrial Air Engineering*

DEPT. P-56, 6 E. 45th St. NEW YORK 17, N. Y.

*Field Engineering Offices in Principal Cities*

INDUSTRIAL COOLING HEATING • DRYING

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HUMIDIFYING • AIR ENGINEERING EQUIPMENT

variations of standard bearings for special and unusual uses, but those in Fig. 16 and 17, and 20 to 23 are the ones most generally applied. Special devices have been added to standard designs to control lubrication, assist in mounting, and so on. Grease-plate bearing, Fig. 16 and 17, has a thin metal or plastic plate, swaged into a groove in the outer ring, and runs with close clearance in a recess on the inner ring. Bearings have a plate on one or both sides. It is not a positive seal but excludes large particles of foreign matter, keeps grease in the bearing, and reduces lubricant flow through it. Double-row design is made with one or two grease plates, and is wider than standard.

*Felt-seal bearing.* Fig. 20 and 22 show this type. A felt washer supported between two metal stampings is fixed in outer ring and rubs in a recess on inner one. This makes a more positive seal than a grease plate but increases bearing's length. A ball bearing can have one or both sides sealed, or have a seal on one side and a grease plate on the other, Fig. 23. Felt-seal design is used where a grease plate does not adequately seal to retain lubricant and exclude dirt.

*Snap-ring bearing.* A flat ring cut through on one side is snapped into a groove on outer ring of bearing, Fig. 21, positioning it in its housing. Snap ring serves as a shoulder machined on the housing, thus simplifying bearing manufacture. This ring is applicable to most bearings. Most popular design is a single-row with snap ring and grease plate for automotive transmissions.

## Pump Q & A

(*Continued from page* 118)

to compensate for alignment changes.

*Q 9—How are a pump and its driver doweled on their bedplate?*

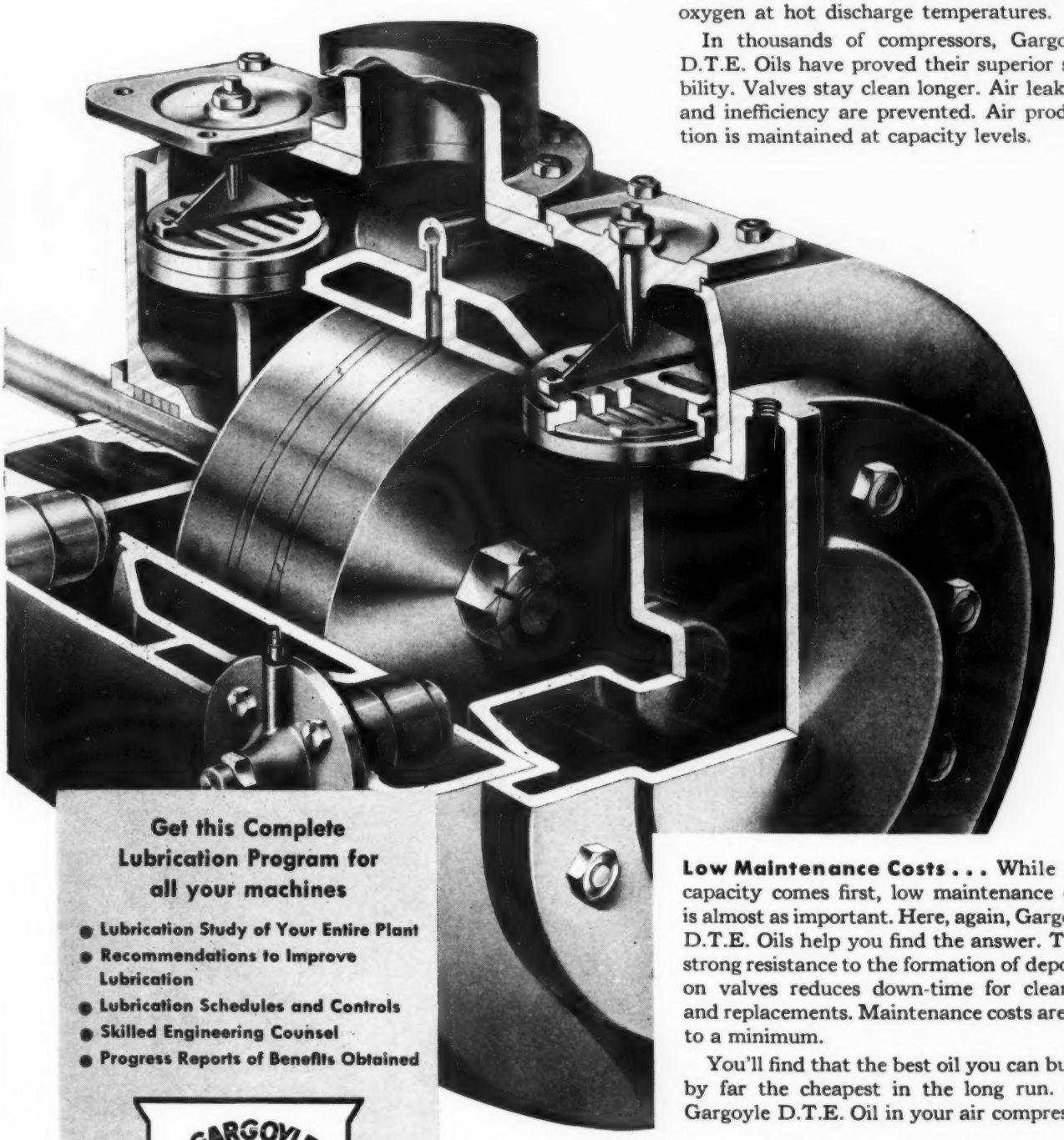
A—The pump's feet are usually doweled at the factory, but the driver's are not. This permits movement of driver for final alignment after which it should be doweled. It is recommended that for hot-liquid applications, doweling of both pump and driver be delayed until after the unit has operated. Recheck alignment with coupling bolts removed and with pump and driver at operating temperatures before doweling.

Special multistage pumps for handling very hot liquids are constructed with a key and keyway on lower half of casing feet and base. Depending on the position of the thrust bearing, one end of the pump is securely bolted while the other

# What do you expect from your Compressor?

**Continuous Full Power . . .** For maximum efficiency, your air compressor valves must stay free from clogging oxidation deposits. This calls for a compressor oil with high chemical stability to resist the attacks of oxygen at hot discharge temperatures.

In thousands of compressors, Gargoyle D.T.E. Oils have proved their superior stability. Valves stay clean longer. Air leakage and inefficiency are prevented. Air production is maintained at capacity levels.



**Low Maintenance Costs . . .** While full capacity comes first, low maintenance cost is almost as important. Here, again, Gargoyle D.T.E. Oils help you find the answer. Their strong resistance to the formation of deposits on valves reduces down-time for cleaning and replacements. Maintenance costs are cut to a minimum.

You'll find that the best oil you can buy is by far the cheapest in the long run. Get Gargoyle D.T.E. Oil in your air compressor.

**Get this Complete Lubrication Program for all your machines**

- Lubrication Study of Your Entire Plant
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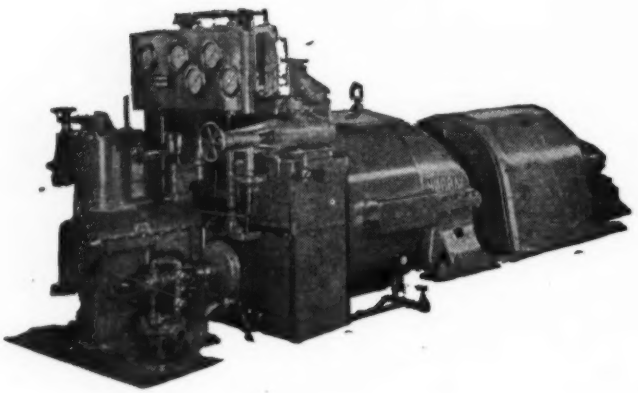
## Socony-Vacuum Oil Company, Inc.

and Affiliates: Magnolia Petroleum Co., General Petroleum Corp. of Calif.

**Tune in "Information Please"—Monday Evenings, 9:30 E.D.T.—NBC**

# MURRAY
## STEAM TURBINE GENERATING UNITS



Installed in 1939 in a small municipal power plant in northeastern Indiana, the above 500 KW direct connected Murray steam turbine generator set has given its owner entire satisfaction. The turbine is equipped with every device necessary for minimum of attention including steam turbine driven auxiliary oil pump. The generator and exciter may be furnished to match existing electrical equipment in your plant.

Units in this size may be furnished either direct connected or geared as preferred with performance and operation equally trouble-free.

There is a Murray representative ready to help you with design and layout information.

**MURRAY *also produces***

**Mechanical Drive Turbines — Horizontal and Vertical Reduction Gears of the high speed type Steam Boilers**

**MURRAY IRON WORKS COMPANY**
**BURLINGTON, IOWA**
Builders of Steam Power Equipment for Three Quarters of a Century


is bolted with spring washers under the nuts on casing feet, allowing one end to move laterally when expanded. In general, all hot-liquid multistage pumps should be doweled at the thrust-bearing end, either in the ordinary way or with the dowels crosswise. Dowels at the other end, if used, are fitted in a similar manner to the key and keyway, that is, parallel to pump shaft to allow the casing to expand when heated.

*Q 10—How should the foundation be prepared for a centrifugal pump?*

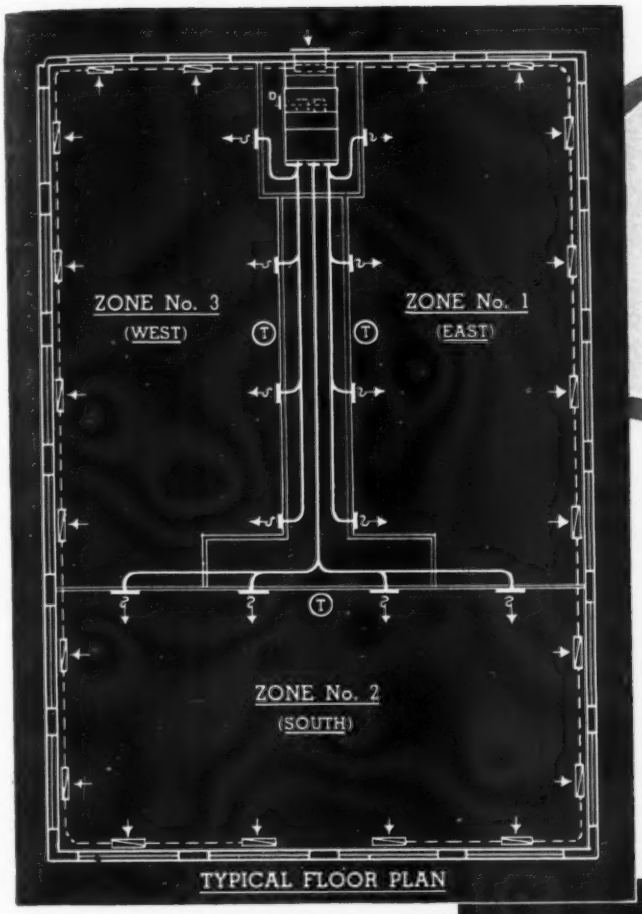
A—Foundation may be of any structure heavy enough to give rigid support to the bedplate and absorb normal strains and shocks encountered in service. Concrete foundation built up from solid ground is the most satisfactory. When building it make allowance for grouting between rough surface of concrete and underside of base.

Locate foundation bolts of specified size according to drawings submitted prior to shipment of unit. Place each bolt in a pipe sleeve having three or four times the bolt's diameter. These pipes permit the bolts to be moved to conform to the bedplate holes. When a pump is mounted on steel work or other structure, place it directly over, or as near as possible to, the main members, beams and walls. Support the baseplate so it cannot be distorted and alignment disturbed by the structure yielding.

*Q 11—How is a centrifugal pump bedplate grouted?*

A—It is ordinarily grouted before the piping connections are made, but in special cases the reverse is permissible. The usual grout mixture for a machine's base is one part cement with two parts building sand and sufficient water to cause the mixture to flow freely (heavy cream consistency) under the bedplate. A wood form built around the outside of the bedplate contains the grout and provides sufficient head to cause it to flow under the entire bedplate. Sometimes this form is put tight against the base's lower outer edge, while on other jobs it is removed a short distance.

For convenience in getting the grout under the base, one or more tin funnels are used at points on the edge. Grout is added until space under the base is filled. Grout holes in the base serve as vents for air to escape. With a stiff wire work the grout through the grout holes to release air pockets. When the grout has set for about 48 hr remove the forms and finish the exposed surfaces of grout and foundation to a smooth surface. When the mixture is hard, after setting 72 hr or more, give the holding-down bolts a



TYPICAL FLOOR PLAN

# ZONE CONTROL using CLARAGE "Blow-Thru" Multitherms

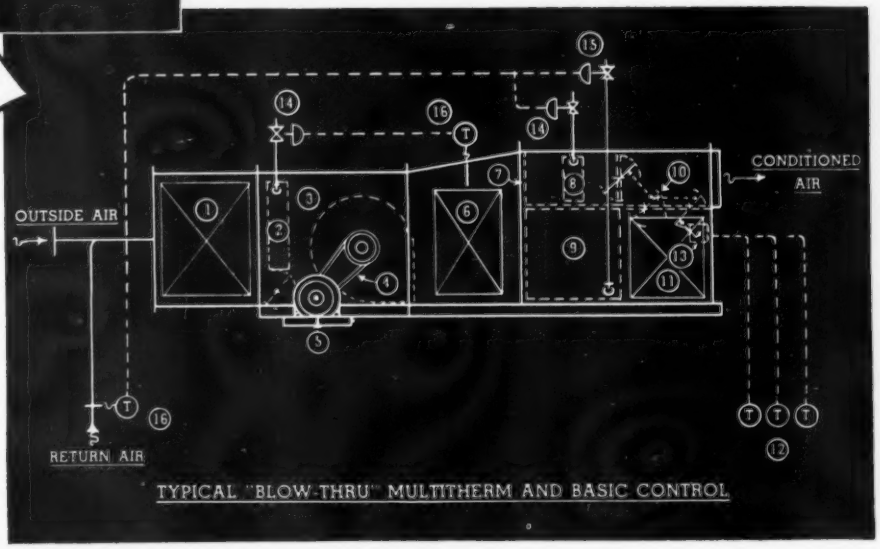
**Now one Clarage "Blow-Thru" Multitherm Unit can be used to air condition various parts of your building exactly as requirements warrant. A typical 3-zone installation is shown at left. Unit can be arranged to serve from two to six zones — an exclusive Clarage development.**

**ZONE CONTROL compensates for the difference in solar radiation on different parts of a building during different periods of the day. It also takes into account variations in exposure, wind velocity, construction, and internal heat loads.**

***Thus winter and summer, if desired, you can maintain various temperatures in various parts of your building. Each zone is automatically controlled independently — yet only one conditioning unit necessary!***

## EQUIPMENT ARRANGEMENT

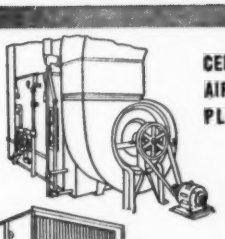
1. Filter Section
2. Tempering Coil with Steam Distributing Tubes
3. Fan Section
4. V-Belt Drive
5. Motor
6. Fan Discharge Section with Access Door
7. Distributing Plate
8. Reheat Coil with Steam Distributing Tubes
9. Cooling Coil
10. Zone Double Mixing Dampers (3 sets)
11. Access Door
12. Zone Room Thermostats
13. Zone Damper Motors
14. Steam Valve
15. Cold Water or Refrigerant Valve
16. Temperature Controller

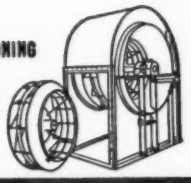


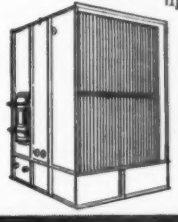
TYPICAL "BLOW-THRU" MULTITHERM AND BASIC CONTROL

## SOME OF OUR OTHER PRODUCTS

UNIT HEATERS


CENTRAL STATION AIR CONDITIONING PLANTS


AIR CONDITIONING AND VENTILATING FANS


AIR WASHERS

*Clarage ZONE CONTROL air conditioning is adaptable to practically any type of building — industrial, commercial, etc. Write for further data.*

**CLARAGE**
**FAN COMPANY**
Kalamazoo, Michigan
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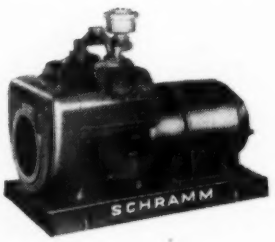
# WHAT TYPE SCHRAMM AIR COMPRESSOR DO YOU NEED

*Do You Need* **DIRECT DRIVE ON BASE?**

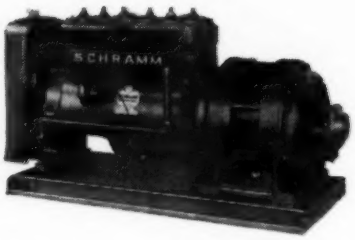
Built-in Motor Drive mounted on steel base is compact and easy to install. No foundations necessary.




*Do You Need*

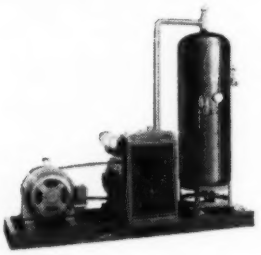
**DIRECT MOTOR DRIVE WITH COOLING UNIT?**

Schramm 300 cu. ft. displacement with direct-connected 50 H.P. motor with cooling unit on Steel Deck Base.




*Or* — **BELT DRIVE WITH TANK AND COOLING UNIT**

mounted and ready for immediate installation? Belt Drive complete with motor, vertical air receiver and cooling unit all mounted on a single base.



SCHRAMM offers you a complete line of Air Compressors for your every need! Sizes range up to 600 cu. ft. displacement! Schramm's stationary units are widely used in plants throughout the country, and are specified because they are vibrationless, lightweight, compact . . . and at the same time easily furnish a steady flow of air. Write today for full details on Schramm Air Compressors.

SCHRAMM INC

THE COMPRESSOR PEOPLE
WEST CHESTER
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final tightening and recheck the coupling alignment.

*Q 12—When are expansion joints used in suction or discharge piping?*

A—They prevent transmitting piping strains to the pump. Frequently on pumps handling hot liquids these joints compensate for pump and piping expansion.

When expansion joints are used, take precaution in the design of the foundation and when mounting pump on it so reactions resulting from flow and pressure conditions are properly absorbed. Advise the pump manufacturer of these conditions, especially when high-head pumps are involved. Thus proper provision can be made to transmit the thrust to the bedplate and foundation, Fig. 3.

*Q 13—Why are vent valves used on pump's discharge?*

A—They permit escape of air, gas or vapor trapped in the casing when liquid is admitted to the pump. While sometimes these gases would be dislodged by the liquid's flow, air or gas in the discharge is objectionable in most systems and should be vented from the pump.

*Q 14—Where should the suction vent be led?*

A—A suction vent on a centrifugal pump removes vapor, air or gas from the suction waterways at the impeller's suction eye. It must therefore be piped to some space of slightly lower absolute pressure than at the suction eye; for example, above the liquid level of the source of supply where the vapor can be condensed or from which vapor, gas or air can be removed. On a condensate pump, the suction vent is piped to the condenser shell or hotwell above the condensate level. Here the vapor is condensed and any gas freed is removed by the air ejector. On a process pump or for petroleum-refinery service a suction vent may have to be connected to a separate vessel, in which a lower pressure is maintained.

Sometimes where the suction pressure is above atmospheric, the pump can be vented, with proper precautions, to atmosphere. A suction vent, on a pump for priming, is connected to the vacuum-producing device.

*Q 15—What arrangement is necessary to dispose of stuffing-box leakage and other drains?*

A—Pipe all drain connections to a sump or sewer. Often the disposal of pump-drain liquid requires a separate sump pump or a water-jet eductor to pump this waste to a sewer.

(*Continued on page* 148)

# IS YOUR STEAM TRAP PIPING A SNAKE'S NEST?

**Do it the EASY WAY**

*STRAIGHT- IN-LINE*

*AS AN ELBOW*

Many steam trap installations look like a nest of snakes—involved, tortuous and confusing. Such piping is necessary with conventional inverted bucket traps but not so with Anderson Super-Silvertop, the trap that made simplified piping practical.

Super-Silvertop (in all sizes) is connected straight-in-line or as an elbow, using only one nipple. You don't have to make your own U-tube outside the trap. Notice that Super-Silvertop gives you BOTH elbow and in-line piping without the use of split gaskets or cored passages. There is no weakness to develop steam leaks or restricted flow. This sound engineering design, plus the saving of as many as 6 fittings and 12 threaded joints, is responsible for the trend towards simplified piping with Super-Silvertop Steam Traps.

The book, "How to Choose a Steam Trap" gives complete details about the engineered steam trap as well as helpful information. Write today for your free copy.

**THE V. D. ANDERSON COMPANY**

**1950 West 96th Street • Cleveland 2, Ohio**

**SUPER-SILVERTOP STEAM TRAP**

ADSCO

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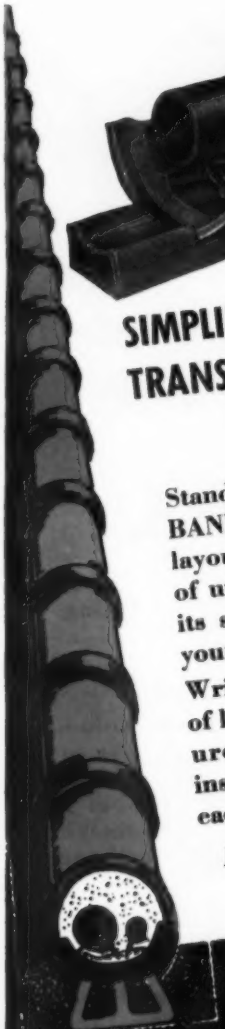
Tile Conduit

SIMPLIFIES UNDERGROUND TRANSMISSION OF STEAM, GASES AND FLUIDS

Standardized design of ADSCO-BANNON Tile Conduit simplifies layout, estimating and installation of underground lines. Look into its start-to-finish advantages for your spring and summer jobs.

Write for quotation giving length of line, sizes of pipes, steam pressure and temperature. Complete installation data is supplied with each order.

*Illustrated Bulletin 35-67 PR on request.*



MAKERS OF UP-TO-DATE STEAM LINE EQUIPMENT FOR OVER 65 YEARS

AMERICAN DISTRICT STEAM CO.

N. TONAWANDA, N.Y.

*Q 16—What is standard equipment for a horizontal centrifugal pump?*

A—Standard equipment generally includes the pump with necessary packing, water-seal piping, seal cages, dowels, plugs, grease cups or oil gages, cooling-water piping if required, vent cocks, and special wrenches, that is, all parts needed for a complete pump on usual applications. Often many of these parts are not assembled, but are separately boxed or bagged and shipped with the pump.

*Q 17—What is a firewall extension?*

A—When a pump handles an inflammable volatile liquid like gasoline, there is a hazard unless the driver is explosion-proof. To avoid this risk, pump and driver are placed in separate rooms with a firewall between them. This arrangement requires a shaft extension with a stuffing box so the driver can be connected to the pump through the wall. Various types of firewall extensions have been used, some of which are shown in Fig. 4, 5 and 6. These extensions have a seal at each end made of a close-fitting felt gasket or of one or more rings of packing with a gland. The space between the two seals is usually filled with a light grease to form a vaportight seal.

## Argument Corner

(*Continued from page* 124)

heated steam the condensate-film temperature is actually slightly higher than with saturated steam. With corresponding pressures, surfaces and coolant, superheated steam has been found to transfer heat at a rate slightly higher than saturated steam. Hence, it can be assumed that the heat-transfer rate in a closed heater will be no lower than for saturated steam at the same pressure. This holds true for any degree of superheat.

A favorable factor with superheated steam is the lesser condensate to be handled. With high superheat the steam-line expansion may be a handicap in requiring higher-quality fittings. However, there will be some improvement in the heater heat-transfer rate.

Some 20 years ago the writer checked the performance of a paper machine fitted with large drying cylinders heated with steam at 20 psig and about 150 deg superheat. A series of thermocouples were mounted inside one of the drier cylinders with the leads brought out through collector rings on the outer end of the blind-end shaft. Some of the thermocouples were installed in the drier-cylinder inner

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This is a typical installation of attractive, unit-type Cabinetrol.

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Cabinetrol saves installation time and expense because it's a single, self-supporting unit. No cumbersome frames—no cluttered walls. Just one attractive, all-metal unit that will greatly enhance the appearance of your mill.

The savings in installation cost that you get with Cabinetrol usually far outweigh its higher original cost. Only two operations are necessary—placing the unit in the designated location and connecting external power, motor, and control leads.

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Cabinetrol is based on the use of standard enclosures equipped with the right combination of standard control devices. Each unit is pre-engineered to meet your specific requirements. All starters and accessory equipment necessary to your application are incorporated in the Cabinetrol unit before it is shipped.

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Because metal-enclosed Cabinetrol is completely deadfront, it offers your operators and servicemen maximum protection. Each motor control is installed in an individual sheet-steel compartment with an interlocking door. Operating mechanisms for motor-circuit switches and air circuit-breakers are available from the front of the panel.

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If you'd like more facts about Cabinetrol ask for Bulletin GEA-3856. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

**G-E INDUSTRIAL CONTROL**

**GENERAL ELECTRIC**

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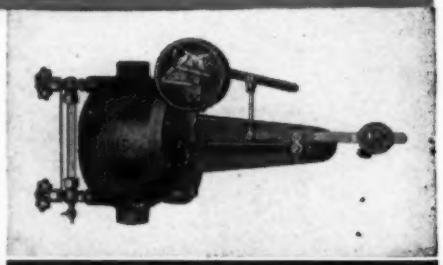
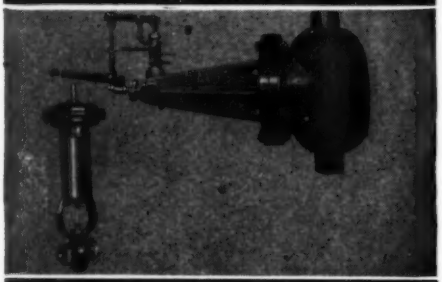
- SIGNAL SWITCHES
- MOTORS
- OTHER EQUIPMENT

DAVIS Float Boxes are used in connection with closed tanks where fluctuation of the fluid level within the tank is the governing factor in the control of all types of electrical switches, control valves, pilot valves, (for operation of diaphragm motor valves), motors and other equipment. Davis fluid control equipment also includes internal float units for direct or pilot operation. Whatever your requirement may be, Davis can supply you with a combination of float box and control valve to make your control accurate, positive, and dependable.

Drop us a card today for detailed information on the Davis line. Ask for Bulletin 101AA. DAVIS REGULATOR COMPANY, 2540 S. WASHTENAW AVE., CHICAGO 8, ILL.

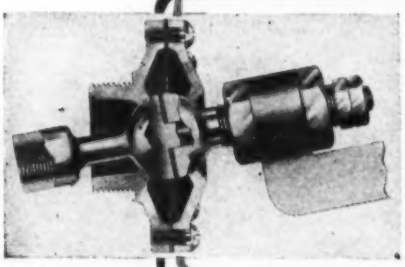


Davis No. 164 Float Box with Mercury Tube Switch.



Davis No. 162D Packless Float Box with Pilot Valve and No. 14 Diaphragm Motor Valve.

## DAVIS DIA-BALL TRANSMISSION UNIT



A patented, leakproof, corrosion resistant packless assembly eliminating the packing box on Davis Float Boxes and Control Valves. Especially recommended for vacuum service or for use with volatile and inflammable fluids where a packing box is objectionable because of leakage For pressures up to 300 lbs. and temperatures up to 450°F.

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face and the others were placed at several points in the steam space. As expected, all the metal surfaces were at about the same temperature and below saturation. There was a zone of superheat temperature extending from the steam-discharge nozzle, but it fell short of actual contact with the cylinder. There was no apparent change in metal temperature with superheated steam compared to saturated steam at the same pressure. Furthermore the drier performance was independent of superheat.

Stage heaters are at times arranged counterflow with a steam-inlet space where superheat is absorbed. On these heaters exit-water temperature is higher than that of saturated steam. Such a 2-stage heater is of special construction and differs from the closed-heater type where all metal is below saturation temperature.

*Seattle, Washington* M S GEREND

### Valve Gear Causes Steam-Engine Trouble

I AM CONVINCED from examining the indicator cards in question 2 (Reader's Problems, Jan 1946) that the valve gear of both cylinders is very much in need of overhauling and that the pipe between the high- and low-pressure cylinders should be replaced with a receiver of larger capacity.

The three cards from the 1-p cylinder show that both inlet and exhaust valves are open for full stroke. This means that there is no cutoff on the working stroke, and no compression on the exhaust stroke. To a certain extent, the 1-p cylinder is acting as a vacuum pump that pulls the steam out of the receiver.

Pressure difference between the h-p exhaust and the 1-p intake shows that the size and shape of the connecting pipe between the cylinders produces the same effect as an orifice. This results in the drop from 40 to 5 psi. The sudden drop in the exhaust line at 100 and 80 rpm indicates that, close to the exhaust valve there is an obstruction, probably a short-radius elbow that maintains a backpressure at the h-p exhaust valve.

At 80 rpm the shape of the compression line shows that the exhaust valve closes in two stages. In the first stage it partly closes, building up pressure; then it completely closes. This indicates poor cam action on both exhaust valves. The slope of the vertical line on h-p cards indicates the inlet valve is leaking or opened too early.

Card shapes indicate that there is a combination of worn or improper shaped cams, and leaking or sticking valves, also some slack in the valve gear.

*Los Angeles, Calif.* H T LIVINGSTON

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Inner core continuous all-metal — in any workable alloy.
Synthetic extruded jackets in long lengths or molded jackets to your specifications.
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Tight against internal pressure or seepage.
Finished assemblies — flexible, durable, neat, economical.

IT IS no small wonder that American Flexible Metal Hose and Tubing has received such widespread use in practically every industry in America. It is as flexible in its application to either product design or industrial maintenance as it is in its actual construction.

The picture above, for instance, shows the latest development in Flexible Metal Tubing combined with synthetics. The result is an absolutely moisture proof, mechanically strong conduit for covering electrical wiring on machine tools. American developed this special product at the request of the machine tool and automotive industry. Brass fittings were especially designed to be either factory attached or for assembly on the job.

This is just one typical example of the thousands of special Flexible Metal Hose and Tubing assemblies that we have designed to solve intricate engineering requirements.

Whether your problem involves the conveying of steam, oil, water, gases or refrigerants at high or low temperatures and pressures — whether yours is a problem of controlling vibration, connecting moving parts or providing for misalignment of tappings — American has a special assembly, flexible enough in both construction and application to give you the right answer.

Write now for literature.

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American Metal Hose

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General Offices: Waterbury, Conn. Subsidiary of Anaconda Copper Mining Company

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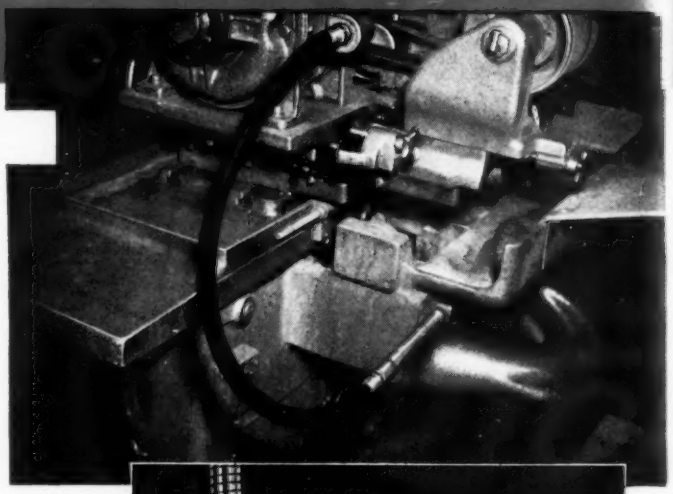
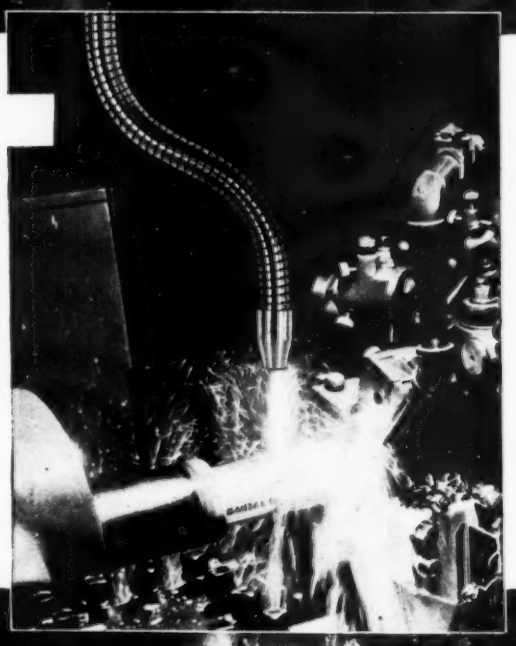
# For DESIGN, PRODUCTION and MAINTENANCE

# *Specify* AMERICAN *flexible* METAL HOSE and TUBING



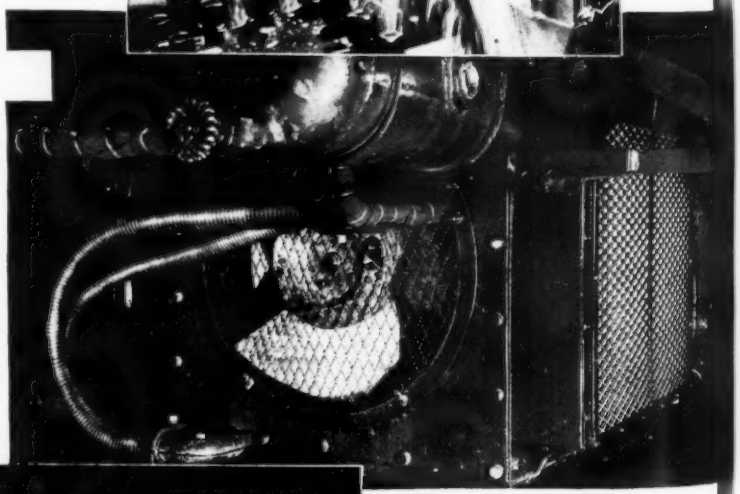
## DESIGN

Thousands of machine and product designers have found that their equipment is more dependable in the long run when they specify American Flexible Metal Hose or Tubing — "right" from the start — because right from the start, they can be sure of a flexible assembly, designed by capable engineers to give the greatest service at the least expense. Where space saving, appearance or positive mechanical dependability are important features, don't take a chance — specify "American."



## PRODUCTION

The war years proved that Flexible Metal Hose and Tubing Assemblies built by American are made to stand up under rigorous production schedules. For instance, one of our customers, a fibre board manufacturer, used American Seamless — the flexible tubing made from seamless tubes — over a period of 9 years in continuous twenty-four hour production WITHOUT FAILURE OF A SINGLE LENGTH. Production men would do well to inquire about the use of American Metal Hose to safeguard production schedules.



## MAINTENANCE

One of the features of American Flexible Metal Hose and Tubing is that couplings can be furnished that are just what the maintenance engineer needs . . . — the type of reattachable couplings that can be put together on the job quickly with ordinary shop tools. To the maintenance man, this means a minimum of spares because abnormal failures can be repaired quickly with no loss of time to valuable production machinery. Write for literature on American Flexible Metal Hose and Tubing.

46336

*American Metal Hose*

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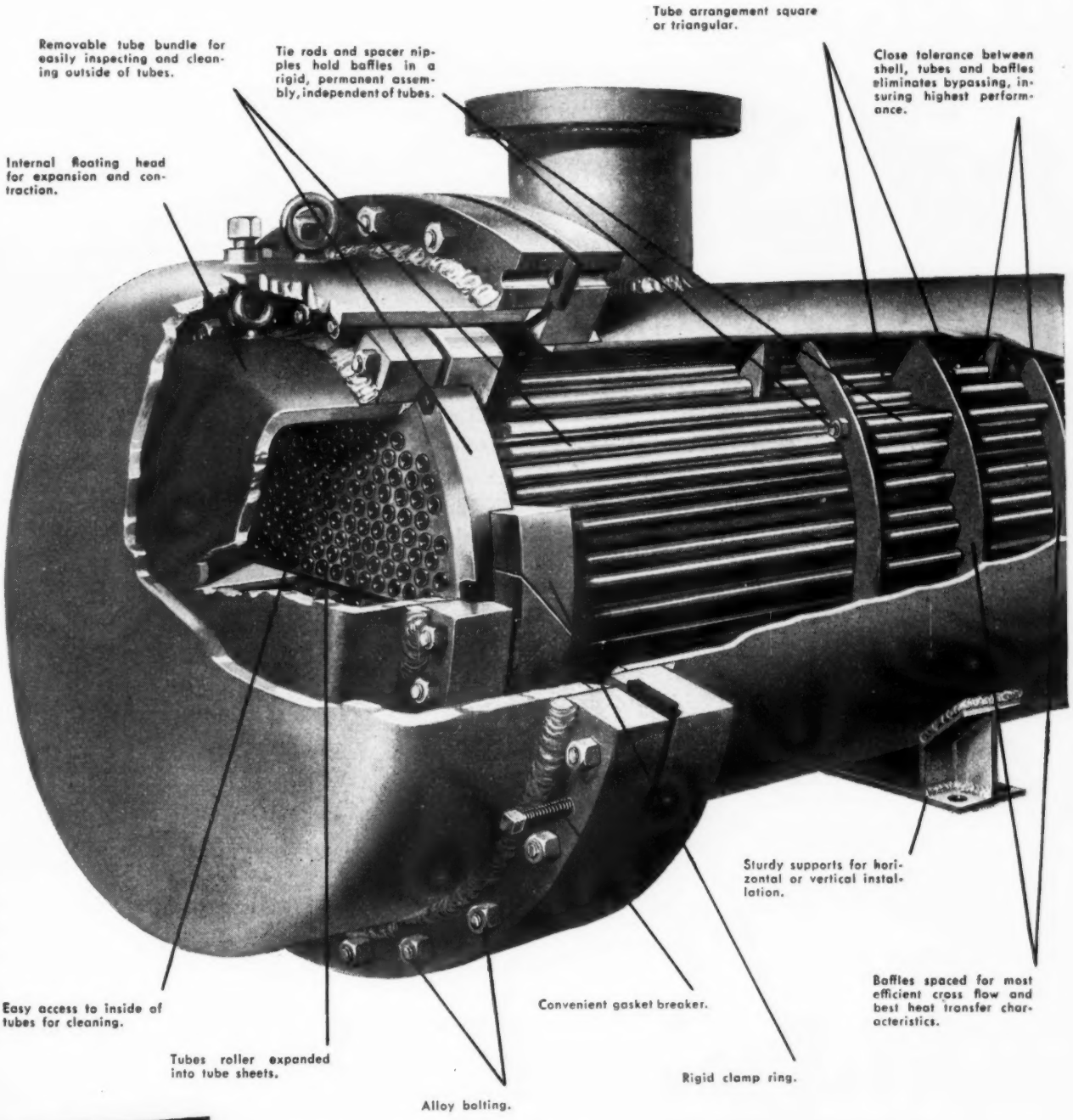
ANACONDA
from mine to consumer

# VITAL POINTS FOR *Your* PROTECTION


Tube arrangement square or triangular.
Removable tube bundle for easily inspecting and cleaning outside of tubes.
Tie rods and spacer nipples hold baffles in a rigid, permanent assembly, independent of tubes.
Close tolerance between shell, tubes and baffles eliminates bypassing, insuring highest performance.
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## Radiant Heating

(*Continued from page* 87)

ASTM Designation A-251, Grades GA65 and GB65 are suitable for wrought iron. Use a welding speed slightly below that for steel and a neutral flame. Slower welding speeds permit slag to float out of the weld. Avoid unnecessary agitation or rubbing because this forms oxides that may be trapped.

Wrought iron is a pure base metal threaded with siliceous slag fibers that give the pipe its corrosion-resistant and durable characteristics. When heated the slag melts first because it is more fusible by several hundred degrees than iron. Therefore, do not confuse the slag flux with the melted base metal. Heat must be applied until the iron melts.

Once the system has been fabricated and laid, and before the slab is poured, test the piping under hydraulic or air pressure of 125 to 200 psi to insure that all welds are tight and pipes undamaged. Keep pressure on several hours.

Controlling a radiant-heating system involves no unusual complications or difficulties. It is essentially the same as a conventional one, principal difference being in size of heating surfaces. A radiant system involves large, low-temperature surfaces while a conventional one depends on small, high-temperature surfaces and air currents to distribute heat.

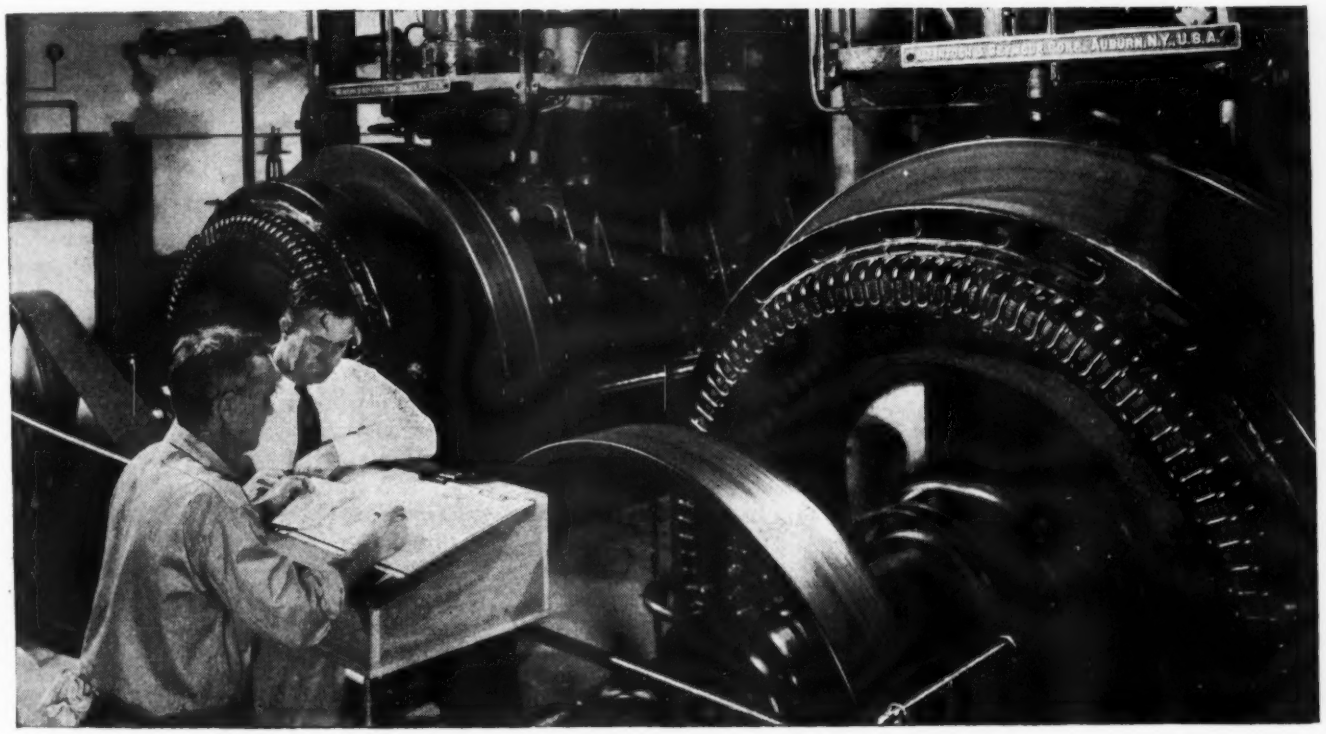
Number of control devices depends almost entirely on the project budget. If sensitive, elaborate controls—such as outdoor-indoor anticipating types—are within the budget, they will function with a radiant system. A large majority of systems, however, have simple, fundamental controls that work successfully.

Many large installations utilize 3-way mixing or blending valves, which involve a bypass around the boiler so water in return lines, still warm enough to perform the necessary heating job, can be blended with reheated water. Either thermostats or aquastats can control inexpensive circulator pumps, usually installed on return lines.

Water removal is not unusually difficult. Most positive method is to slope or pitch the pipes about ¼ in. every 10 ft and install a drain line at a common low point. If the installation is too large for gravity drainage without creating design problems, blow out the system with compressed air. Complete analysis of reasons for draining a heating system, during shutdown or nonuse in freezing weather, shows it is unneces-

# *Superior Lubricating Value:*

## Another important advantage of the improved **GULF PARVIS OIL**



"Not only do we have very low maintenance expense with Gulf Parvis Oil, but we have a 16-year record of uninterrupted service to our customers in spite of greatly increased load," says the Superintendent of this modern light plant.

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You can also get longer lasting protection of your Diesels through its greater resistance to oxidation! And the remarkable anti-foam agent in Gulf Parvis Oil successfully prevents foaming regardless of operating conditions, yet in no way diminishes its lubricating qualities.

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sary to become overly concerned about the problem. Shutdowns from lack of power or fuel usually are short and theoretically the thermal-storage capacity of the structure—particularly when coils are installed in concrete slabs—can be expected to hold temperatures above freezing until service is restored. During periods of temporary nonuse, it appears more economical to reduce temperatures to about 50 F than to shut down and drain not only the heating system but all plumbing as well.

Fabrication and installation costs for radiant-heating systems have dropped during the past few years as techniques have improved. Labor costs, naturally, are the important and determining economic factor in any heating installation. They need not be any higher than for an ordinary installation if methods for design, fabrication and installation are practical.

From an operating standpoint, radiant heating is economical. Apparent fuel economy up to 35% has been recorded on some installations. However, economy is difficult to measure since it is virtually impossible to duplicate construction, temperature and other conditions necessary for comparison. Theoretically, heat losses are lower than in a conventional system where heat concentrations along exterior walls and at ceilings are not only wasted but transmitted outdoors, thereby requiring additional fuel to produce the comfortable environment readily effected by radiant heating. It provides healthful, desirable working conditions by reducing drafts and dirt circulation and permits more advantageous use of floor space because heating elements are concealed.

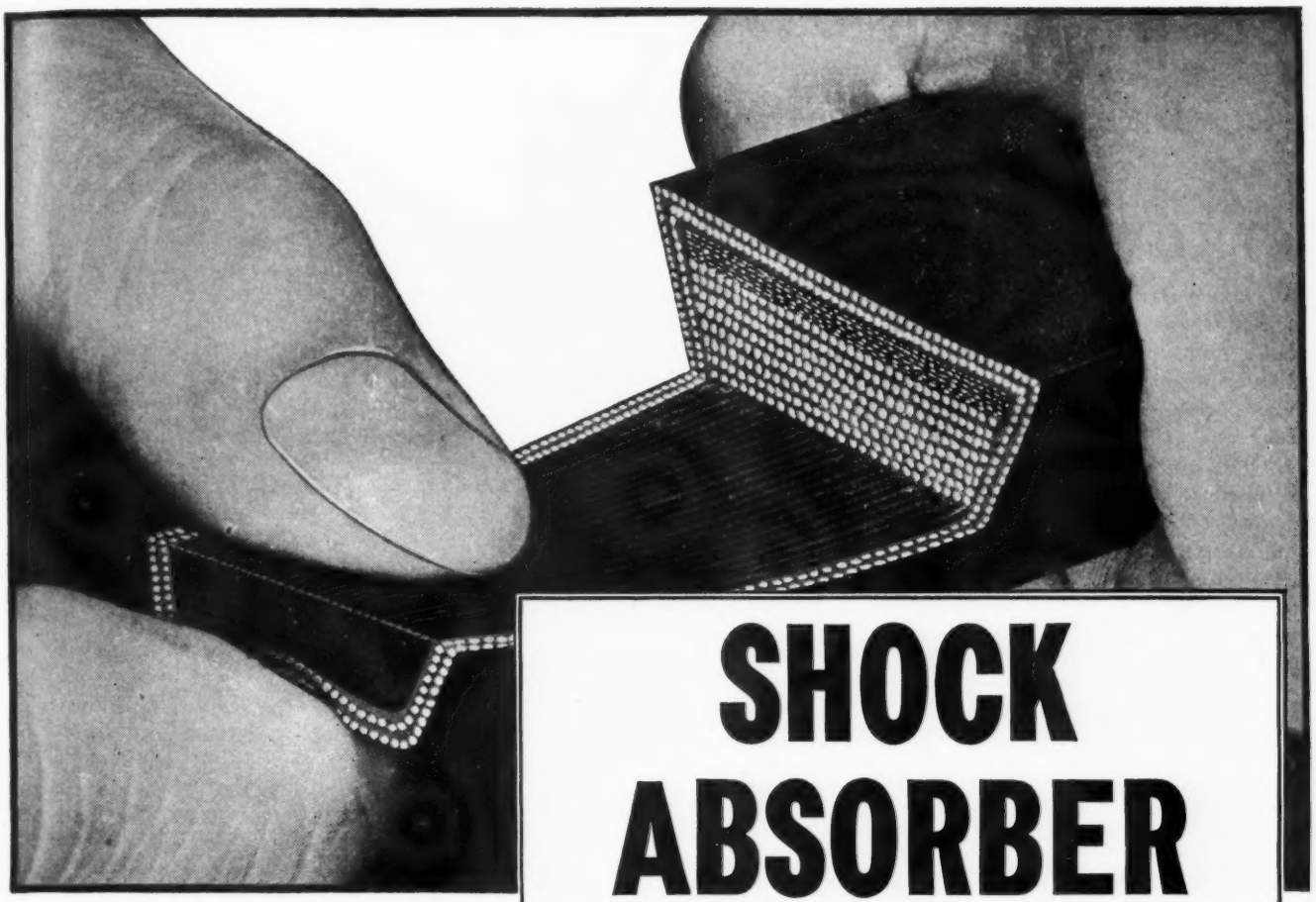
### *Typical Installation*

A recent project illustrates how radiant heating was adapted to a specialized function in the Montgomery County Infirmary Hospital, outside Dayton, Ohio. A central steam-power plant services the several existing buildings.

This one-story hospital is laid out like the letter X. Dining rooms and similar facilities are in the center of the X, easily accessible. The four wings contain individual rooms and wards. While this design is most suitable for the specialized occupancy, each wing is subjected to different exposures, thus creating a difficult heating problem for the designer and the institution's engineers.

First step in designing the radiant-heating system was to calculate heat losses, in accordance with standard coefficients, just as for a conventional system.

The hospital contains 30,000 sq ft of floor surface, divided into four heating



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Under the load-pulling cord section of every TEXROPE V-Belt lies a thick, springy cushion of cool-running Buna-S. This cushion acts as a shock absorber to protect the cords from stresses that might weaken them. This carefully proportioned cushion is one of the reasons why TEXROPE "Super-7" V-Belts are known by all industry for their long life and smooth, efficient power transmision. Other reasons are: *More Cords, Stronger Cords,* hard-twisted of selected long staple cotton — *Tough Duplex Cover* to resist wear and keep out dirt — *War-Proved Buna-S* — an improved, cooler-running rubber compound developed for TEXROPE Super-7 V-Belts.

**YOUR V-BELT DRIVE HEADQUARTERS**

Call your Allis-Chalmers office or dealer for TEXROPE Super-7 V-Belts — for full range of standard, "Magic-grip" and Vari-Pitch sheaves — for Speed Changers and complete V-Belt Drive engineering help. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

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Stands temperatures up to 180°. The TEXROPE V-Belt for most drives.

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Neoprene cover protects core against moderately oily or greasy conditions.

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Made of Neoprene throughout. Use it when the belt must swim in oil.

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Recommended where explosion hazard exists. Static-conducting element throughout cover won't wear off.

**Super-7 Steel**
Twin steel cables, to pull extremely heavy loads with minimum stretch.

**GET THEM — through your Allis-Chalmers district office or dealer.**

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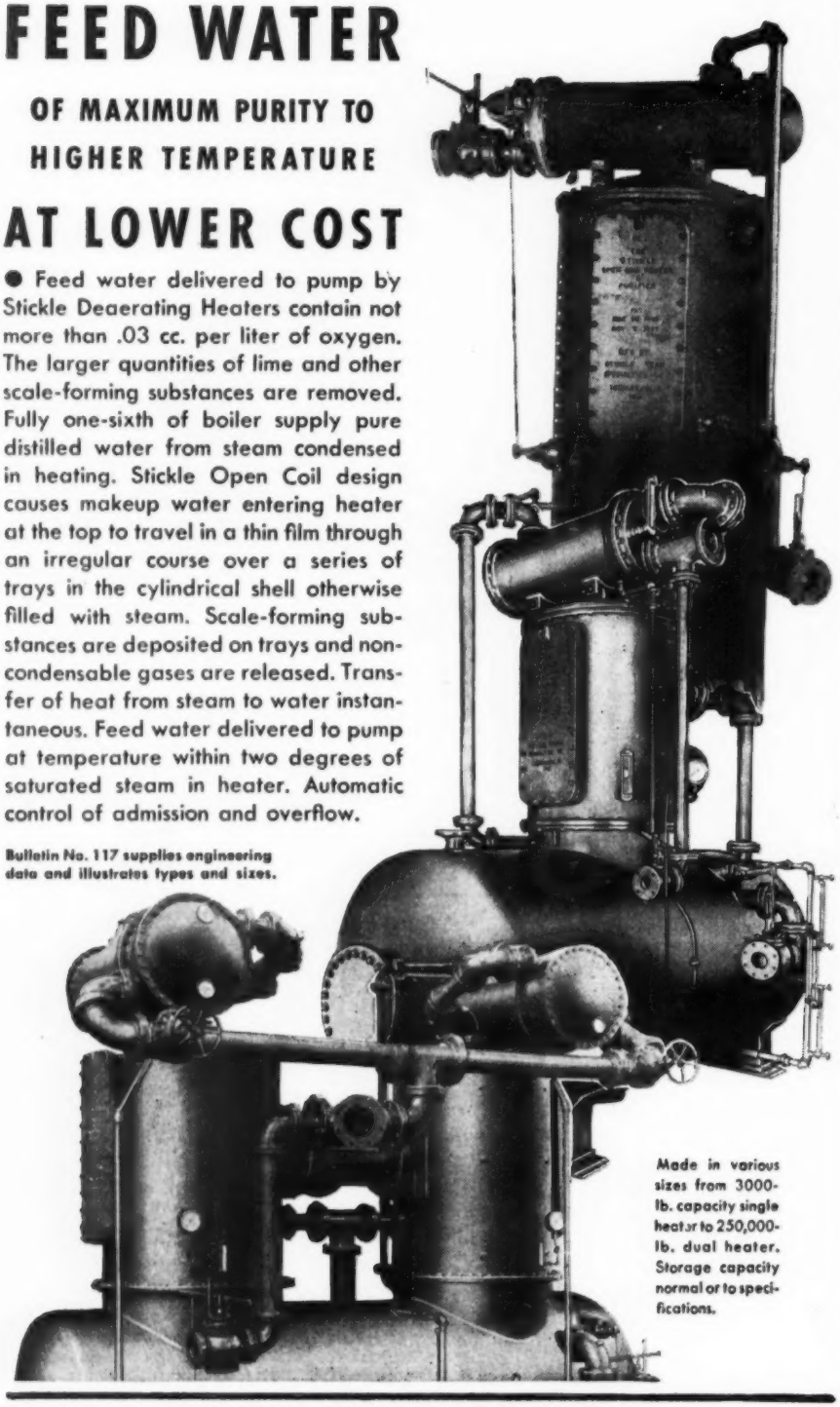
● Feed water delivered to pump by Stickle Deaerating Heaters contain not more than .03 cc. per liter of oxygen. The larger quantities of lime and other scale-forming substances are removed. Fully one-sixth of boiler supply pure distilled water from steam condensed in heating. Stickle Open Coil design causes makeup water entering heater at the top to travel in a thin film through an irregular course over a series of trays in the cylindrical shell otherwise filled with steam. Scale-forming substances are deposited on trays and noncondensable gases are released. Transfer of heat from steam to water instantaneous. Feed water delivered to pump at temperature within two degrees of saturated steam in heater. Automatic control of admission and overflow.

Bulletin No. 117 supplies engineering data and illustrates types and sizes.



Made in various sizes from 3000-lb. capacity single heater to 250,000-lb. dual heater. Storage capacity normal or to specifications.

### OTHER STICKLE EQUIPMENT

**Stickle Differential Drainage and Boiler Return System**—a closed pumping system that returns condensate under pressure from processing units to boilers at temperature only slightly lower than that at which it leaves traps. Bulletin No. 250.

**Stickle Regulating and Reducing Valves**—two series in standard types designed and constructed for industries requiring dependable and accurate control within extremely close limits of variation. Bulletins Nos. 235 and 435.

**Stickle Open Float Steam Traps**—in four series designs to meet specific operation conditions. Traps for high, medium, and low pressures and for vacuum service. Specify use in request for bulletin.

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zones, one for each wing. Hot water for the floor coils is supplied through a 425-gpm converter designed to handle a 20-F water-temperature drop, from 135 in supply mains to 115 F in returns. Steam for the converter is piped at 25-psi pressure from the central power plant through a 5-in. wrought-iron main in a 15-in. conduit, lined with mineral wool. The conduit also contains a 2-in. condensate return.

Four 2.5-in. wrought-iron supply mains run from the converter through pipe tunnels to the four heating zones. Individual 100-gpm circulator pumps, pumping against a 50-ft head, are installed on each circuit. The return mains, also 2.5-in. wrought-iron pipe, run to a small, partial basement, under the building's central portion, which houses heat exchanger and circulator pumps.

Sinuous heating coils were selected because of the individual rooms' and wards' small size and the ease of fabrication. These coils, all fabricated at the site on a special bending tool devised by the heating contractor, were made of 1¼-in. wrought-iron pipe spaced on 12-in. centers. The coils were laid on a 4-in. gravel fill, covered with waterproof paper, Fig. 4. A 4-in. concrete slab, poured over the pipes, completely embedded them, and a 2-in. terrazzo floor was laid on the concrete. Structural reinforcing rods were utilized in the concrete slab.

Supply lines from the mains to individual-room coils run adjacent to the exterior walls of the rooms so the hottest water reaches these cold areas first, Fig. 1. They were tapped with balancing cocks to regulate water flow, thereby controlling heat input into each room. Once adjusted for desired comfort, the cocks do not have to be regulated during the heating season. Ordinary room-air thermostats control water temperature for the system. Rial T. Parrish was architect-engineer of the job.

---

**In a move to spur production** of residual fuel oils, which are scarce in most parts of the country, Office of Price Administration has raised ceiling prices at all levels of distribution throughout United States and in Hawaii, Porto Rico and the Virgin Islands. The increase amounts to a half cent a gallon or 21 cents per barrel everywhere except in Wash., Ore., Calif., Nev. and Hawaii, where the increase is 15 cents per barrel.

**President Truman** sent to the Senate recently the nomination of Claude L Draper of Wyoming for membership on Federal Power Commission. Mr Draper, who has been a member of the commission for more than a decade, was appointed to the term expiring June 22, 1951. He is one of two minority members of the commission.

**...and** its place—in this particular case—is in the steam lines of the air conditioning and heating plant of one of the largest department stores in Washington, D. C. Installed by the Armstrong Cork Company, K&M Distributor, "Featherweight" is once again demonstrating that it is the most efficient of the moulded-type insulation materials.

Designed for pipe surfaces carrying temperatures up to 600° F., it is extremely light in weight, absolutely fireproof, and sufficiently strong mechanically to withstand all ordinary usage ... and then some. "Featherweight" 85% Magnesia has even emerged unscathed from the usually damaging effects of floods or trips to Davy Jones' locker!

In factories, ships, refineries ... K&M "Featherweight" 85% Magnesia has always led the way in keeping heat in its place. Once installed in YOUR plant, it will banish your insulation problems for good. Why not write us for further details?

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## Midwest Conference

(*Continued from page* 102)

is available at temperatures not exceeding 80 F. But a new supercharging cycle under development permits removing heat from supercharging air at a high level of temperature and thus makes possible use of an air-to-air intercooler.

A series of sessions on hydro power included discussions of development of three river valleys. These were: "Present Status of Proposed Hydroelectric Development of the St. Lawrence River" by C H Giroux, special assistant to Chief of Engineers; "Hydroelectric Power in the Missouri Basin" by B H Greene, regional engineer, Federal Power Commission; and "Objectives and Benefits of the Wisconsin Valley Improvement Company" by M W Kyler, general manager, Wisconsin Valley Improvement Co. A fourth paper on hydro operation, "Spillway Gate Operation to Prevent Erosion Below Dams," was presented by Arno Lenz, University of Wisconsin.

### *Varied Electrical Subjects*

Papers in the electrical field were quite varied, ranging from insulation development to subjects such as rotating regulators, damper windings for generators, power interchange between systems, transient electric phenomena and cable developments.

G L Moses, Westinghouse Electric Corp, in "Silicones Offer New Approach to Insulation Problems," pointed to the useful application of this relatively new material in electrical apparatus. Since temperature is a primary basis for establishing general machine ratings and silicones have great thermal endurance, they can be used by designers in three ways: (1) to reduce size and weight of apparatus through increase in operating temperature (2) to permit operation in a high ambient temperature and (3) to obtain increased insulation service life or reliability where it is desired to maintain conventional size, weight and temperature.

Operation and functions of the electrical control apparatus, known by the trade names of Amplidyne, Rototrol and Regulex, have been summarized in a paper entitled, "The Application of Rotating Regulators," by L T Rader, Illinois Institute of Technology.

In his paper on "Damper Windings for Waterwheel and Diesel-Engine-Driven Generators," W L Ringland, Allis-Chalmers Manufacturing Co, concludes that most effects of a damper winding on generator performance can readily be pre-

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SIMPLE DESIGN

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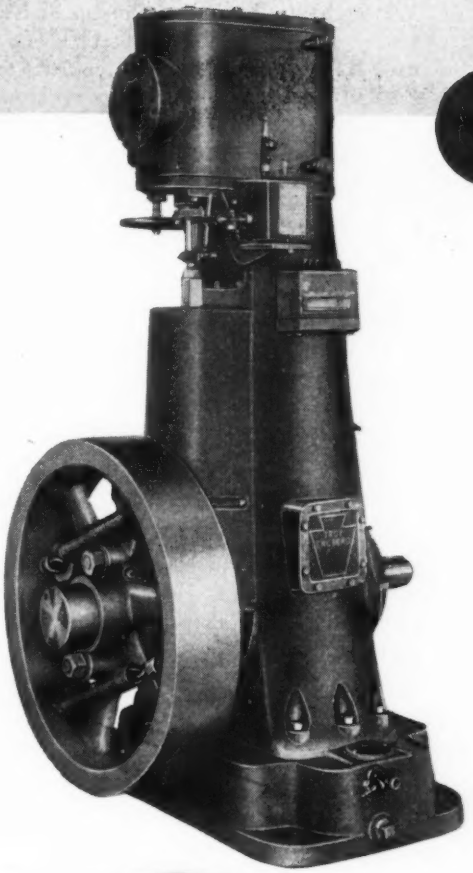
CONSERVATIVE SPEED



Thousands of Troy-Engberg Steam Engines have been operating for 10 to 20 years, even longer, without need of major repairs. This contributes to the exceptionally low power cost produced by these engines throughout industry.

Why not investigate the advantages of using the Troy-Engberg Steam Engine in your plant? If you use steam for processing or heating and if you are operating such equipment as compressors, blowers, pumps, stokers, generators, etc... you have the setting for a profitable investment in low cost power.

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*Bulletin No. 306 will give you information on the Troy-Engberg Steam Engine. Shall we send you a copy?*

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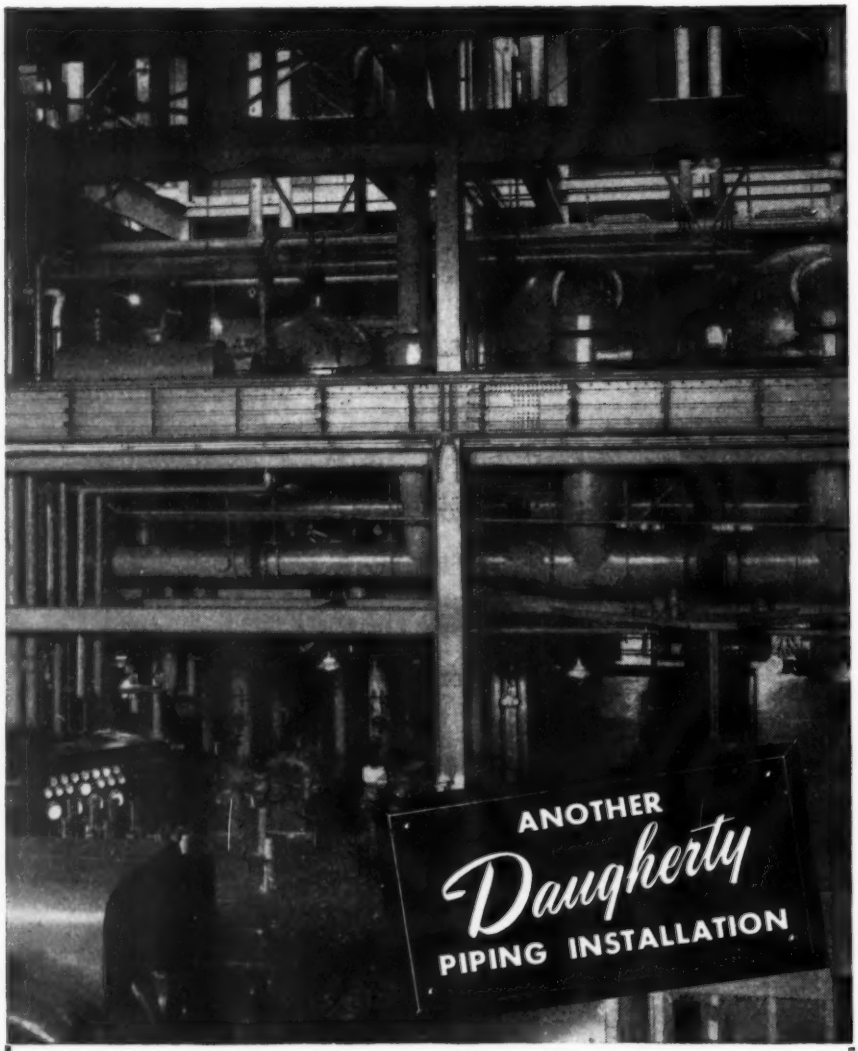


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This 850 lb., 900 degree Power Piping Installation is an example of the specialized fabrication and erection experience which Daugherty Company provides to the power and process industries.

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PIPING CONTRACTORS for the POWER and PROCESS INDUSTRIES

determined if operating conditions are known. Evaluation of this performance in terms of dollars return on investment is more difficult, but it must be done in some manner for every new generator purchased.

Elements that must be considered for energy interchange between interconnected systems were discussed at length in a paper by C W Mayott, Hartford Electric Light Co. Use of this technique in providing additional capacity and energy during the war were also described.

### *Miscellaneous Subjects*

An interesting summary on "Transient Electric Phenomena as a Power System Design and Operating Problem" was presented by H A Peterson, General Electric Co. The value of modern mechanical and electrical calculating devices in studying these conditions is stressed.

Cable types were discussed in a paper entitled, "Review of Present and Future Conditions in the Cable Field," by R J Wiseman, The Okonite Co.

In sessions on developments in air conditioning and space heating, the following papers were presented: "Centrifugal Compressors" by W H Carrier, chairman of the board, Carrier Corp; "Cooling Tower Selection" by J Lichtenstein, Foster Wheeler Corp; "Radiant Heating" by T Napier Adlam, vice-president, Sarco Co; and "Industrial Applications of the Heat Pump" by Philip Sporn vice-president and chief engineer, E R Ambrose, air-conditioning engineer, and Theodore Baumeister, consulting engineer, American Gas & Electric Service Corp.

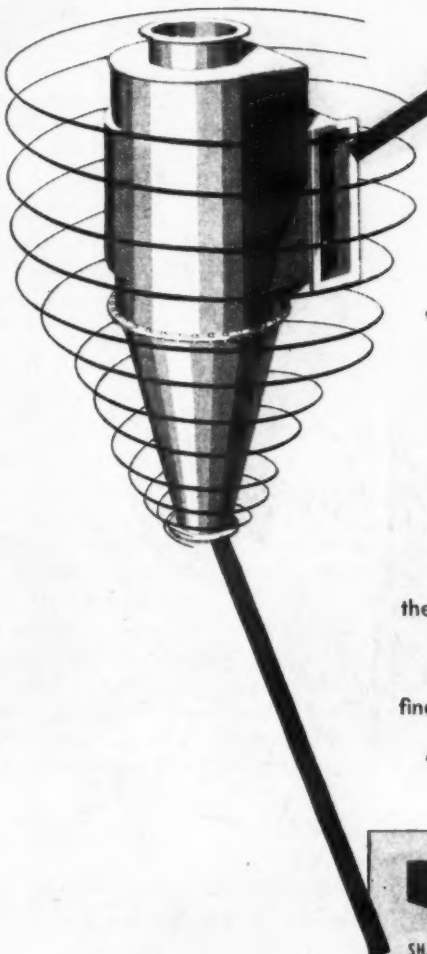
### *Conference Proceedings*

All technical papers presented at this conference will be available in the form of proceedings, to be issued at a later date. Copies may be ordered from Prof Stanton W Winston, Illinois Institute of Technology, Chicago, at $2.50 per copy.

Innovations of the 1946 conference included a symposium on "Your Nation's Future—an Engineering Problem." F A Faville presided at this meeting to promote engineering participation in public affairs. Speakers were M J Evans of Melvin J Evans Co; L J Fletcher of Caterpillar Tractor Co; S R Harrell of Acme Evans Co; A A Potter, Purdue University; and Roy V Wright, Simmons-Boardman Publishing Co.

David Levinger, vice-president and works manager, Western Electric Co, was toastmaster at the All-Engineers dinner. Speakers were Lt Gen R A Wheeler, chief of engineers, US Army; Rear Adm W G Taylor (for Rear Adm J L Manning, chief of Bureau of Yards and Docks, US Navy); and Brig Gen G Armstrong, commanding officer, Army Industrial College.

# Consult Buell *First* in Dust Recovery



Buell Fly Ash Collectors, employing exclusively the well-known van Tongeren System of dust collection, are internationally known throughout industry for "High efficiency, Low maintenance, Long life." Among their outstanding qualities and performance characteristics are: (1) high efficiency mechanical flue dust collection to meet the specific requirements of any job, (2) ready adaptability to any existing duct work, (3) low initial cost, (4) low maintenance and operating cost, (5) power consumption as low as 1 H. P. per 20,000 pounds of gas per hour. Buell's Bulletin, illustrated above, explains in chart and illustration the Buell (van Tongeren) principle of industrial dust recovery.

Every operating executive and engineer will find it most helpful in the selection of dust recovery equipment for his particular requirements.

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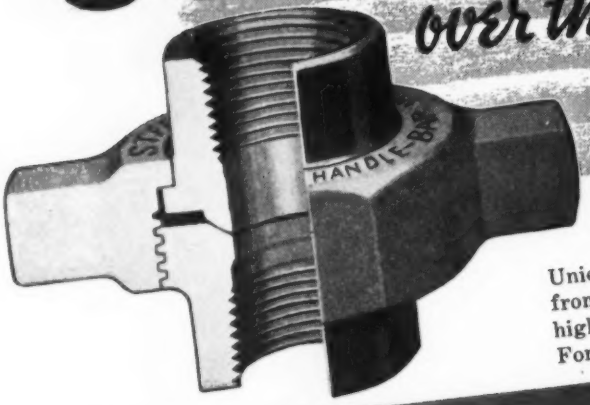
# Service over the years with FORGED STEEL UNIONS



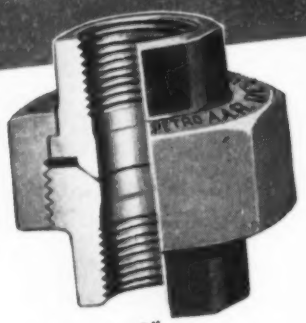

Unions are hot forged from solid round bars of high quality Open Hearth Forging Steel.

## Handle-Bar

Hi-Speed Handle-Bar Unions with integral steel to steel seats, or completely fused bronze to bronze seats, black or Udylite (cadmium plated) — sizes from ⅜" to 4" inclusive in 4000 test, sizes 2" to 4" inclusive in 6000 test.

4000 Test Unions furnished with Briggs Standard steam threads in pipe ends, whereas the 6000 Test Union has long pipe ends with API line pipe threads. Nut threads are modified Acme to facilitate easy and speedy assembly and disassembly. Seat design is a 45 degree cone, machined and cold rolled, to a ball seat on male end. Handle-Bar Unions are recommended for all services where they are made up and taken down frequently.

## Petro



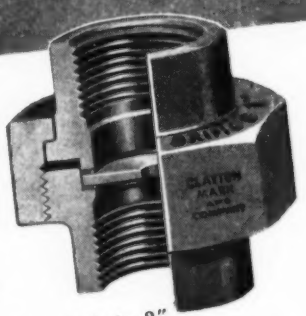
Sizes ⅛" to 3"

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is used.

## Orifice

Ideal for flow control of Steam, Oil, Ammonia, Water, Gas or Air. Also for metering and measuring. 600 lbs. S. W. P. or 2000 lbs. C. W. P. The ORIFICE plate is furnished in cold rolled 18-8 stainless steel. ORIFICE plate and gaskets are set in a groove of solid steel to safeguard against blowing of gaskets and resultant trouble. The ORIFICE union has extra heavy ends and nut with the nut threads permanently lubricated.



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## Reader's Problems

(*Continued from page* 113)

necessary to change the governor-collar position. Through the linkage to the steam-admission valves this change in governor position reduces the amount of steam admitted to the engine cylinders to the amount required to carry the 250-kw load at a speed slightly above synchronous speed of the utility system. The fact that the engine speed increases to a point where the overspeed safety device shuts the engine down indicates either a very close speed setting of the overspeed trip or defective governor mechanism. Assuming that the overspeed device trips at a speed about 3% to 5% above normal, engine racing probably results from wear in governor linkage. Therefore before the governor travel is transmitted to the steam valves excessive friction in the linkage requires greater engine speed to give the governor sufficient force to move the valves.

Engine should not overspeed enough to release its overspeed trip if the governor, linkage and valve gear are in good mechanical condition. Overspeed trip should be properly adjusted so it will not release until a speed of about 5% above no-load speed inherent for the governor has been reached.

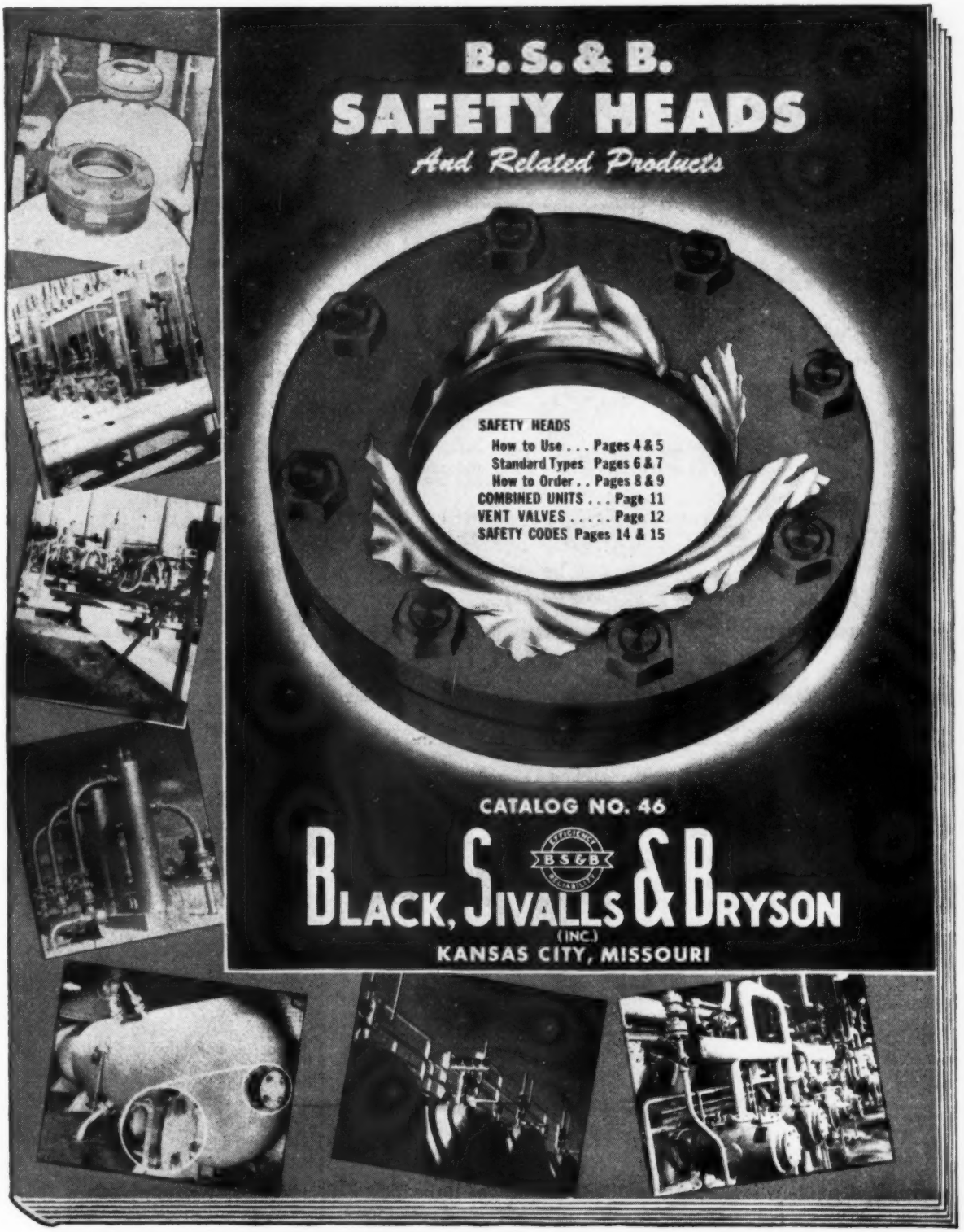
Frequency of the utility system is controlled within very close limits. Control of *JAE's* engine speed would necessarily have to be within equally close limits for its generator to operate in synchronism with the utility system. If this is not maintained it will feed to the utility lines when the building load drops to a point where this entire building load can be carried by the engine generator set. This close governing can be accomplished only by an isochronous governor in which compensation for changing loads is automatically provided to maintain a constant speed.

*Seattle, Wash.* J H BENDER

### Operate Engine From The Throttle Valve

TO CHECK THE OPERATION of his governor *JAE* should take all tension off the auxiliary governor spring. Start the engine and gradually open the throttle valve until engine reaches operating speed; at this point check the governor to see whether it holds the speed down.

If the governor controls the speed at no load then apply load and check governor operation at various loads up to the full 300 kw. If the governor controls the speed under these conditions without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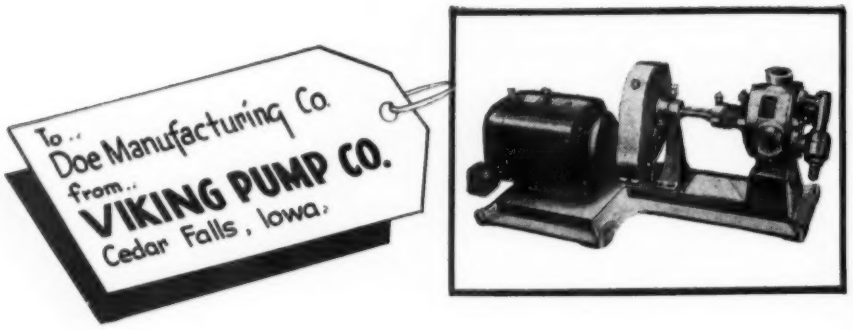


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1. Simple — 2 moving parts — "Gear Within A Gear" principle.
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3. Only one outside packing box — to eliminate leakage.
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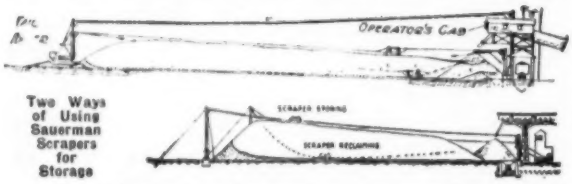
## ONE-MAN SCRAPER SYSTEM

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Users will tell you how it has put handling and storage on the most economical basis—how it makes better, safer stockpiles, and reclaims coal at only a few cents per ton. The Sauerman Power Drag Scraper is a *one-man* machine that serves as a self-loading conveyor, with large handling capacity, and long reach. It utilizes full ground space, any size or shape. It builds higher piles, free from air pockets. It protects from spontaneous combustion. Reduces dust. Get the catalog and see for yourself.

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**562 S. Clinton St., Chicago 7, Ill.**


tripping from overspeed the trouble may be in the auxiliary-spring adjustment.

A spring-loaded governor operates in a stable manner only when the spring characteristics are such that spring tension and centrifugal force of governor weights are balanced.

When spring tension is greater than the centrifugal force exerted by the governor weights the governor moves the valves to position of maximum cutoff and causes the engine to overspeed.

*Plymouth, Mass.* C B HUDSON

### Adjust Valves For Light Loads

VALVES ON *JAE's* STEAM ENGINE may have been adjusted so the governor no longer controls them at light load. Racing from this cause, which usually occurs only at light loads, is prevented by adjusting the governor linkage so valves may shut off completely at no load.

Wear, poor alignment and wobbling are likely to affect governor operation, as they would any other mechanical device. Close adjustment and good action are not always possible where trouble of this sort is present.

Another point to remember is that good governing is usually impossible when engine valves are in poor condition.

*Hamilton, Ont.* S G PATERSON

### Increase Setting of Reverse-Current Relay

*JAE* SHOULD BEAR IN MIND that when pressure is applied by a synchronizing spring to a governor the process tends to retard its action. Evidently the unit that causes trouble is fully loaded or slightly overloaded at 300-kw load. The steam valves, therefore, would have full opening and the governor would be riding in its lowest position. Low steam pressure or other varying condition could cause the unit to drop load below that chosen by the governor. Naturally the utility system would pick up this load. If these conditions were reversed, reaching such proportions as to cause the reverse current relays to operate, there would be a current surge and an increase in frequency. Because of the low position of the governor and the retarding effect of the synchronizing spring the governor would not be fast enough to get control of the engine before it overspeeded.

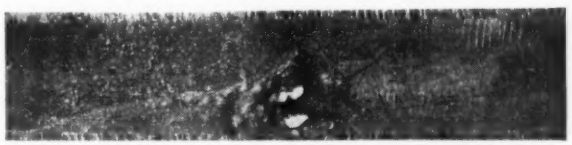
I think *JAE* will eliminate the trouble if he resets the reverse-current relays to allow a greater exchange of load between the two systems.

*Duluth, Minn.* E R WEBBER

# HOW THE ANODIC POINTS WERE CAPTURED

In many cases where a condenser tube has proven unsatisfactory in a given application, analysis of conditions will show the cause of the failure to be outside the tube itself.

A Scovill engineer was requested to explain the puzzle of the consistent failure of tubes in the first pass of a marine condenser. 18 tubes had failed in this pass, as the result of intense local pitting.



**Deposits Had Done It** — He found that the pitting was due to "deposit attack", an electrochemical type of corrosion initiated by foreign material lodged against the tube walls. Where such deposits covered the metal, those "islands" became anodic to the adjacent uncovered areas, with resultant intense corrosion of the anodic area. In this case, turbulence of the water passing around the deposit caused erosion-corrosion on downstream side of deposit.

Examination showed no evidence of any other type of corrosion.

The suggestion of the Scovill engineer which aided in the solution of the problem was to modify the circulating water inlet and to establish a regular practice of cleaning the tubes, using rubber plugs, bristle brushes or other equipment that would not score the tube walls.

**Three Scovill Services** — Scovill *Service in Men* provides specialized study and advice on individual tube application problems and on installation practices. *Service in Metals* includes production of many tube alloys, and also offers you the facilities of our laboratory to help determine the alloy best suited to your conditions. *Service in Manuals* provides valuable literature on condenser and heat exchanger tubes; for a free copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 13 Mill St., Waterbury 91, Conn.

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What are you piping? Water? Air? Chemicals? Steam? You're losing whatever you're piping if you have leaky stuffing-boxes in valves or pumps. But, losses don't stop there! When you shut down to replace prematurely worn or improper packing, you sustain needless *production losses*. Careful selection of the *right* packing can prevent such waste.

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for steam, water, air. PELRO for oils. CUTNO for alkalis. SUPERCUTNO (blue asbestos) for acids. KLERO for foods.

## New Equipment

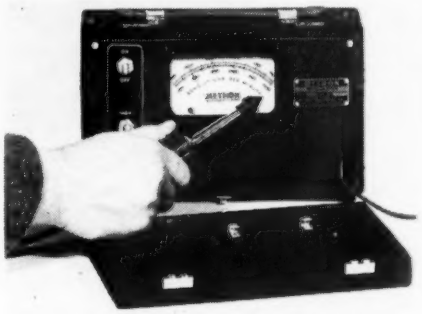
(*Continued on page* 128)

trial heating furnaces where close regulation is necessary and (3) gas or air flow proportions in industrial processes where end result is dependent on maintenance of uniform or precisely adjustable conditions. **Dept P, Control Div, Hagan Corp, Hagan Bldg, Pittsburgh, Pa.**

### Overspeed Tachometer

METRON 48A SENSITIVE TACHOMETER is for overspeed testing of turbines, generators and motors. This portable tachometer has two ranges for testing either 1800- or 3600-rpm machines. The 1800-rpm range is from 1700 to 2200, and 3600-rpm range is from 3400 to 4400. There are only two controls—an on-off switch and a high-low range switch.

Though electrical in nature, this instrument operates on a new principle, employing neither generator nor magneto. Operating power is obtained from an ac source of 105 to 125 v, 60 cycles. The head, which is small



and requires only ¼-in. oz to rotate, is a positive-acting switch connected through a reactance in a bridge circuit so meter indication in bridge circuit is directly proportional to number of switching operations per min of head. Neither the balance nor response of bridge circuit is affected by line-voltage fluctuations between 105 and 125 v as instrument has a built-in stabilizer. Tachometer contains no vacuum tubes.

Instrument is supplied complete in carrying case with instruction card, neoprene contact tips and shaft extension for reaching recessed shafts. This tachometer is also available with other ranges for specialized applications. **Dept P, Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.**

### Water Heater

DESIGNED FOR STEAM PRESSURES of 50 to 150 psi, O'Brien all-bronze steam-mixer water heater is complete with automatic temperature-pressure controls, safety relief valve and easy-reading thermometer. The condensate is utilized as hot water and no condensate-return system is required. Compact and complete, O'Brien packaged wall unit is easily installed near point of application so there is no waste of hot water and time in waiting for long lines to fill. New muffler diffuser eliminates excessive noise that ac-

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Chamfers accurately machined for thread protection and easy thread engagement.
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INFILCO

# How this plant met *emergency* demands for carefully treated boiler feed water...

*Another unusual test of Infilco performance.*

Soaring demands for boiler feed water pushed the Infilco installation pictured above to *sustained* operating rates of 115% of capacity . . . and at times to higher rates. That steady, above-capacity schedule was maintained by a large oil refiner. During the emergency period, treated water continued to be uniform. But there's more to be told about this record.

Behind this record was careful control over operations—plus clock-like performance of the equipment used. There was automatic proportioning and application of chemicals with Infilco Chemical Feeding and Proportioning equipment . . . zero oxygen content of raw-treated water and condensate with Infilco Internal Deaeration . . . thorough pre-treatment with the unique design of the Infilco Hot-Flow Sedimentation Tank. These are some of the reasons why Infilco Hot-Flow installations produce soft, non-corrosive, non-scaling water . . . for regular and emergency demand.

Unusual demands such as this may not arise overnight—often. But when they do, it's important to have water treating equipment that will meet the test. Write for Bulletin 1850. Infilco Inc., 325 West 25th Place, Chicago 16, Illinois.

CONSULT INFILCO — FIRST IN WATER AND TRADE WASTE TREATMENT

# TO KEEP POSTED!

**Send for this 60-page manual which presents, both pictorially and schematically, various popular systems with related equipment for handling coal from receiving point to stoker—and removal of ashes — in any size plant.**

***Ask for Catalog 778***

# THE JEFFREY MANUFACTURING COMPANY

973-97 North Fourth St., Columbus 16, Ohio

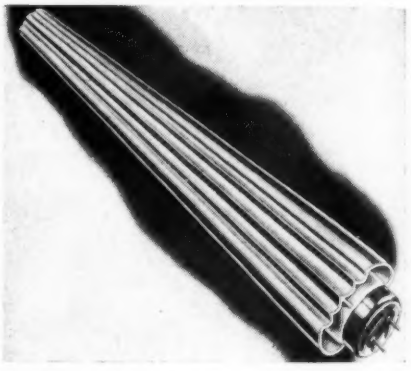
ESTABLISHED 1877

companies direct mixing of steam and cold water.

Capacities range from 600 to 5500 gal per hr at 100-deg temperature rise. Standard temperature ranges are 100-140 F, 120-160 F, 140-180 F and 160-200 F; intermediate ranges between 100 and 200 F. Special ranges below 100 or above 200 F, with adjustment of 20 deg plus or minus, are available. **Dept P, O'Brien Steam Specialty Co, 335 Heffernan Bldg, Syracuse 2, N. Y.**

## Conveyor Trolley

NEW TROLLEY has no wheel shafts, or spindles, and does not require separate retainers for its full complement of hardened alloy-steel balls. The two basic elements (wheel and one-piece bracket) form the deep inner and outer races of bearing. Trolley is easily mounted on or removed from the chain, even though chain and track are in place. As unit bracket forms outer race of the bearing, all loads and reactions are transmitted direct to bearing. Inclusion of both outer bearing race and the carrying attachment in a single bracket results in fewer parts and more pleasing appearance. **Dept P, Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.**



## Plastic Diffuser

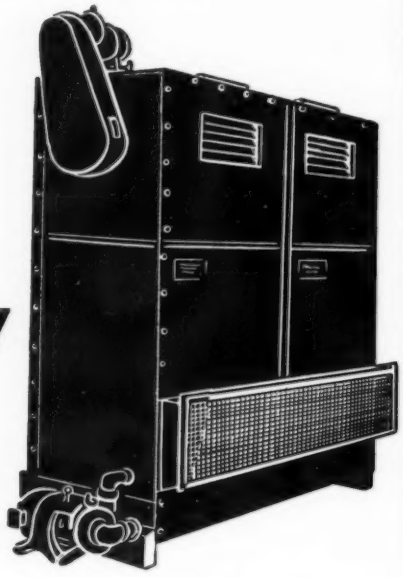
GUTH PFC-100 4-foot white plastic diffuser easily snaps on or off a 40-watt (T12) fluorescent lamp. PFC-100 affords pleasant light diffusion that minimizes direct and reflected glare. The new diffuser has a spring-like patented design that grips the lamp along its entire length to afford easy cleaning and relamping. Snug-fitting PFC-100 helps shield lamps and confines heat of lamp itself for better, more consistent operating temperatures. **Dept P, Edwin F Guth Co, 2615 Washington Ave, St Louis, Mo.**

## Portable Brazer

FOR MAKING LAP JOINTS in copper strap, attaching terminals to cable, brazing coil ends and general coppersmithing work, portable 5-kva brazer consists of a transformer, voltage selectors, controls and carbon-tipped tongs. Ac from an adjustable-voltage transformer passes through tongs and parts to be brazed, raising temperature to a point at which brazing alloy melts. Brazing alloy may be applied in form of a rod or in ribbon form. This brazer requires connection to a 220-v source.

Three outlets are provided on the control panel for 8, 6 or 4 v. Voltages are easily and quickly adjusted by inserting


# Operating Efficiency of Evaporative Coolers Improved This Easy, Low-Cost Way



Are your evaporative water coolers and condensers giving below-par performance? Are your operating costs creeping upward? Often unsuspected, though frequently at fault, is the cooler's water supply. By treating recirculating water this newly developed Oakite way you can prevent hard lime scale and slime from interfering with cooler and condenser efficiency.

Simply add to sump water supply tank recommended quantity of Oakite material. This scientifically designed chemical agent keeps lime particles in suspension so that they cannot settle on cooler coil surfaces to act as insulation. In addition, this Oakite material has potent germicidal and fungistatic properties that discourage the growth of slime and algae in tank, on suction screens, coils and eliminators.

## Technical Data FREE

A specially prepared 4-page Field Service Report giving comprehensive technical details on low-cost evaporative water cooler and condenser maintenance cleaning is available to you FREE on request. Ask us to mail you a copy TODAY!

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*Technical Service Representatives Located in All Principal Cities of the United States and Canada*

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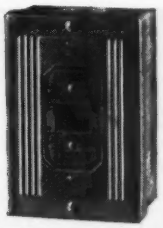
**MATERIALS · METHODS · SERVICE · FOR EVERY CLEANING REQUIREMENT**

# Wherever you need...
# OVERCURRENT PROTECTION

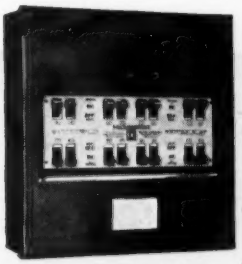
## You save time and money with Square D Circuit Breakers

Weatherproof, Dust-Tight and Explosion-Resisting Circuit Breakers.



MO Multi-breaker for use on small machines.

Industrial Circuit Breakers in standard sheet steel enclosures.



Multi-breaker Load Centers for controlling and protecting lighting and small power circuits.

Rain-tight Multi-breakers with a variety of circuit arrangements.

Industrial Multi-breakers in capacities from 15 to 100 amperes, with 2 or 3 poles.

Multi-breaker Load Centers in Cast Iron Enclosures for Class 1, Group D and lower applications.

Multi-breaker Type M Load Centers with 50 ampere frame breakers for applications involving 120-240 volt AC circuits.

## HERE'S HOW YOU SAVE TIME...

1 *Harmless momentary overloads pass without breaking the circuit, due to a time-lag feature built into every Square D Circuit Breaker.*

2 *Restoration of service is quick and easy. No replacing of fuses. A simple movement of the operating lever restores current after the cause of the short or overload has been eliminated.*

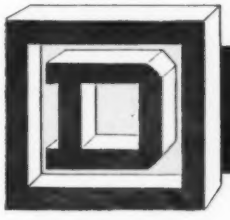
## HERE'S HOW YOU SAVE MONEY...

1 *Fuses are eliminated—no replacement of parts is necessary.*

2 *Electrical equipment has constant proper protection, because every Square D Circuit Breaker unit is factory-sealed and consequently tamper-proof.*

## Square D makes exactly the Breaker you need

● Square D's *complete* line enables you to select exactly the right device for any given installation. A wide variety of enclosures, including general-purpose, raintight, dust-resisting, and explosion-resisting. Capacities range from 15 to 600 amperes, up to 600 volts. Send for INDUSTRIAL CIRCUIT BREAKER BULLETIN which illustrates and describes the complete line.



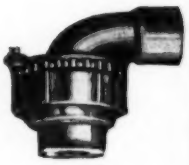
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

FOR FULL, UNRESTRICTED FLOW OF FLUIDS OR PRESSURES TO MOVING PARTS

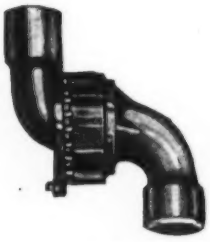
# FLEXO JOINTS

"A"



"B"

*give full range of movement*



"F"

"G"

Flexo Joints provide the flexibility of hose with the strength of pipe for conveying steam, air, vacuum or fluids under pressure. Wherever swing joints are required for connections to moving parts, Flexo Joints assure free range of movement for complete 360°.

Flexo Joints are fully enclosed against dirt and grit. No springs, small loose parts or ground surfaces to wear.

Flexo Joints are available in the four styles illustrated here for pipe sizes from ¼" to 3".

*Send for detailed information.*

**FLEXO SUPPLY CO., Inc.** 4224 OLIVE ST. St. Louis (18), Mo.

*In Canada:* S. A. ARMSTRONG, Ltd., 115 Dupont St., Toronto (5), Ontario



*TROUBLE-FREE roller bearing COAL GATE with double rack and pinion*

● Maximum performance is built into Beaumont Birch Roller Bearing Gates. These drip-proof, self-cleaning gates will not corrode, bend or warp, nor can material collect in the back of the gate. Even under punishing service conditions, these gates operate manually or electrically without strain or ramming. Write today for descriptive bulletin.

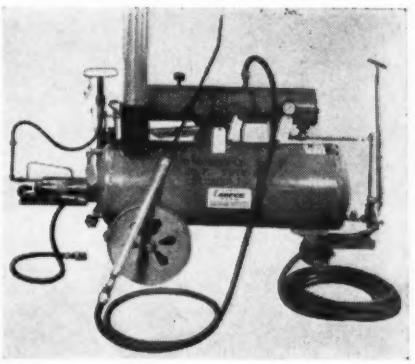
**BEAUMONT BIRCH COMPANY**
1502 RACE STREET • PHILADELPHIA 2, PA.


bayonet plugs attached to brazing leads into plainly marked receptacles. A foot switch with pilot cable serves as primary control switch.

For use with air-cooled tongs, brazer is supplied with a handle for carrying. The 30-lb unit is cooled by natural air circulation. Air enters bottom of case and is expelled through louvered opening in top. **Dept P, Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa.**

## Solder

TRI-CORE is a solder with three independently filled cores of pure rosin flux. Arrangement of the three cores places them closer to the surface. Since the walls are thinner than those of single-core solder, according to maker, not only does the solder melt more quickly, but the heat penetrates to the flux more rapidly, allowing it to flow freely and reach work ahead of molten solder. Careful cross-sectional proportioning and absence of surface seams prevent premature sweating out of the flux, making it clean to handle at all times. *Tri-Core* solder is available in all alloys, flux percentages and gages. **Dept P, Alpha Metals, Inc, 369 Hudson Ave, Brooklyn 1, N. Y.**



## Steam Cleaner

ONE OPPERATOR can speedily remove grease, dirt and grime from motor blocks, electric motors and other industrial equipment with this automatic steam cleaner. It produces steam in ten minutes. It is used with a specially prepared chemical. Device, consisting of a short piece of rubber hose with pressure strength of 90 psi, protected by a safety shield with open end toward the generator and closed end toward the operator, provides safety if popoff sticks or valve becomes corroded. Steam cleaner is made of boilerplate steel with all seams electric welded, and has three wheels for convenient portability. Large-capacity tank holds 30 or 40 gal of water, 7 gal of low-cost fuel oil. **Dept P, D C Cooper Co, 1467 S Michigan Ave, Chicago 5, Ill.**

## Variable-Stroke Pump

DISTINCTIVE FEATURES of Worthington *Variflo* pumps, according to maker, are as follows: (1) Stepless capacity variation from 0 to 100% is accomplished with a simple, compact mechanism. (2) There is high efficiency over full range of capacity and pressure. (3) A standard constant-speed motor or turbine may be used for driving with re-

# EVERY CC GETS AN OK

**It's *compact*, but it handles *full flow***

**It's *positive*, but it never interrupts *production***

***Every drop of the fluid you want cleaned gets cleaned by the Cuno "filter-fine" strainer.***

No larger than the usual partial-flow type, it handles full flow without the necessity of an expensive, space-consuming duplex installation. Every drop of the fluid is inspected by the permanent, all-metal filter element — built-in or externally mounted.

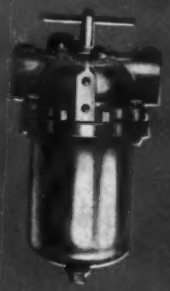
Providing absolute certainty of removing all particles larger than specified (down to .0025"), it is also continuously-cleanable *while in operation.* No production delay due to a clogged filter — or for cleaning the filter.

The Cuno catalog in SWEET'S tells which Cuno model is best for your requirements — or send for complete catalog (use coupon). Cuno's engineering staff will also help you on special conditions.

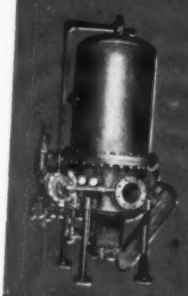
KEEP FLOW ON "GO" WITH

**CUNO**

ENGINEERED FILTRATION



AUTO-KLEAN *disc-type.* For all fluids except those containing highly abrasive solids. Viscosities from 30 to 50,000 Saybolt seconds. Minimum pressure drop. Continuously cleanable by turning a handle (manually or automatically). Occupies no more space than usual partial-flow type. Sizes from 1¼" diam. x 7⅛" cartridges to massive motor-driven models. Available with or without sump for built-in or external installations.



FLO-KLEAN *wire-wound.* For fluids containing highly abrasive solids such as metal chips, abrasive wheel particles, sand, etc. May be designed to remove particles .0025" or larger. Continuously cleaned by backwash system. Low pressure drop — fluid moves in straight line, encountering only momentary restriction. All parts made of metal — constructions to meet varying corrosive and erosive conditions.

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**CUNO ENGINEERING CORPORATION**
**226 South Vine Street, Meriden, Conn.**

Please send me a free copy of your catalog. I am especially interested in the services checked.

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- ☐ Alkali
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- ☐ Coatings
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- ☐ Fuel Oil
- ☐ Fuel Tar
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- ☐ Grease
- ☐ Grinder Coolant
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- ☐ Solvents
- ☐ Spray Systems
- ☐ Tar
- ☐ Test Stand Lubricating Oil
- ☐ Varnish
- ☐ Washing Compounds
- ☐ Water
- ☐ Wax

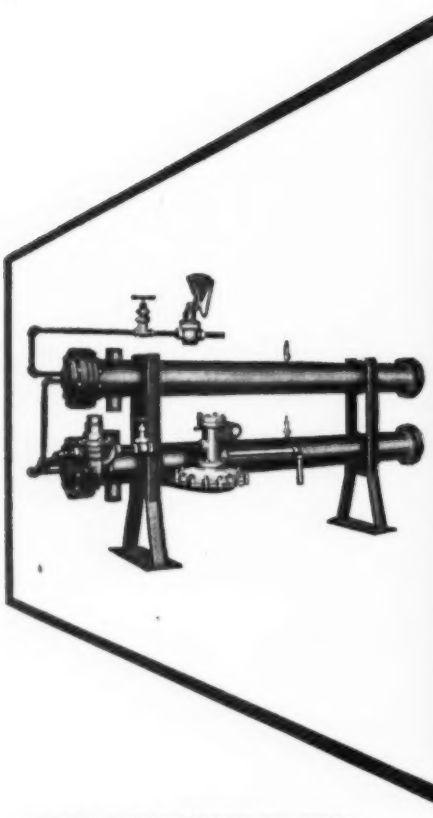
Others .....

*Name*.....

*Company*.....

*Address*.....

*Title*.....



INSTALLATIONS IN:

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- Dairy Plants
- Chemical Companies
- Steel Industries
- Paper Mills
- Textile Plants
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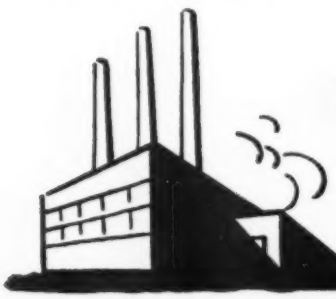
- Canning Companies
- Cereal Processors
- Breweries

# HENSZEY *Continuous Blowdown*

**Look at the wide variety of industries that take advantage of the low cost power and clean steam that a Henszey Continuous Blowdown System can provide. That partial list is a typical cross section of American industry. Which means that you, too, should consider a Henszey system in conjunction with your present or planned boilers.**

**The Henszey system keeps boiler water concentration within safe margins — preventing foaming, priming, carryover, and the formation of sludge and scale (with proper chemical treatment). All this is accomplished continuously, automatically, and WITHOUT the heat loss of ordinary blowdown.**



*Contact your nearest Henszey representative or write to*

**HENSZEY COMPANY**

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## CONTINUOUS BLOWDOWN *and* BOILER PLANT SPECIALTIES

**Boiler Feed Regulators • Distillation Systems • Heat Exchangers**
**Feed Water Meters • Flow Indicators • Proportioning Valves**
**also MILK EVAPORATORS and PREHEATERS**


sulting over-all economy in power consumption. (4) Pump is for all free-flowing liquids. (5) Crankshaft and stroke-changing elements are a self-contained assembly with all parts pressure lubricated. (6) Stuffing boxes are on top of cylinder, making routine attention easy. Eccentric shaft is at bottom, engine style, resulting in loads being transmitted and supported close to foundation. Running parts are fully inclosed. (7) *Variflo* pumps have Worthington patented flange and screw stuffing-box gland. This gland tightens up evenly on the packing, and gland cannot become cocked when adjustment is made. **Dept P, Worthington Pump & Machinery Corp, Harrison, N. J.**

## Washing Compound

BEX UT-30 is an amber liquid which, extended with 10 to 500 parts of water, is said to clean any surface to which water may be applied. Chemically neutral, it is claimed to have no adverse effect on skin, cloth, metals or plastics. Odorless compound is in 5- and 54-gal drums. **Dept P, Gaybex Corp, P O Box 3, Nutley 10, N. J.**

## Fire Extinguisher

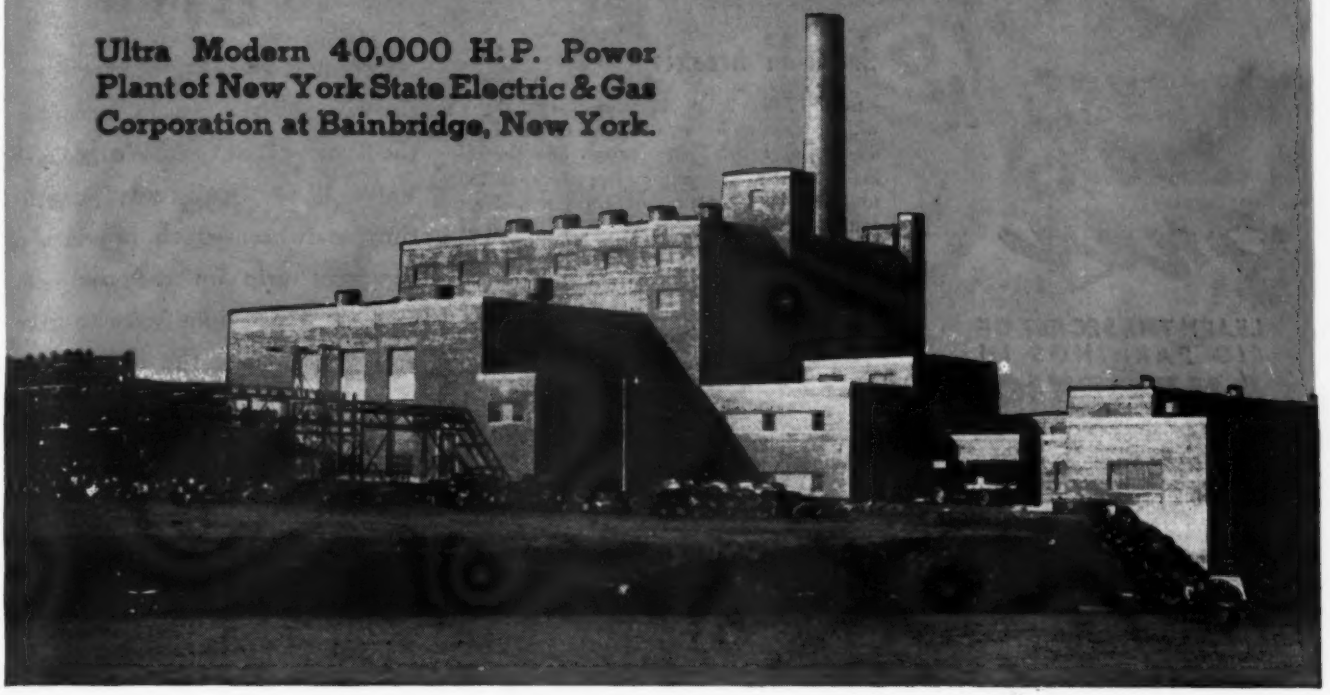
ALL-OUT DRY CHEMICAL is ejected, under pressure, in a flat stream that separates the flame from the burning material. Instantly forming a dense, fire-smothering cloud over a flaming area up to a distance of 18 ft, *All-out* creates an insulating barrier between operator and flame, providing protection from radiant heat. On hot-metal surface the dry chemical forms an insulating film, helping to guard against dangerous re-flash. *All-out* is said to perform effectively under all climatic conditions. **Dept P, ALL-OUT Fire Extinguisher Div, Pressurelube, Inc, 609 W 134th St, New York, N. Y.**

## Pressure Gage

BELLOWS LOW-RANGE PRESSURE GAGE indicates draft pressures or any low pressures of gases or liquids that are not corrosive to bronze. The pressure element is a self-draining bronze bellows with a phosphor-bronze calibration spring. Adjustable stops protect bellows from excess pressure or vacuum. It is supplied in 4½- and 6-in. phenol cases with ¼-in. male pipe thread, low or back con-

# JENNISON GENERATING STATION

**Ultra Modern 40,000 H.P. Power Plant of New York State Electric & Gas Corporation at Bainbridge, New York.**



All of the fabrication of the high and low pressure piping for this exceptional plant was performed by Shaw. The fabricating was coordinated with the erection schedules as planned by Gilbert Associates of Reading, Pa., who were consulting engineers on the project.

This work is typical of the tasks Shaw is equipped to perform in the piping pre-fabricating, installation and erection field.

*Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping—any place in the United States and Canada.*

Benj. F. Shaw II
PRESIDENT

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There are plenty of big jobs today in Combustion Engineering. Such jobs have always been big pay jobs—and today they are better than ever. High fuel and equipment costs means a greater demand for combustion trained men than ever before.

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and many others.

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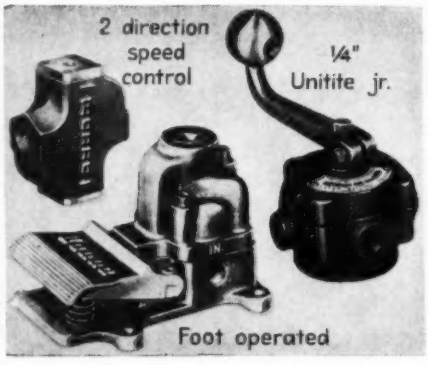
nection. Type 1188 P is supplied in pressure ranges from 10 in. of water up to 10 psi. It is also supplied as a low-range vacuum gage, Type 1188 V, in vacuum ranges from 10 in. of water up to 20 in. of mercury vacuum. **Dept P, Manning, Maxwell & Moore, Inc, Bridgeport 2, Conn.**

## Emulsion Breaker

VISCO 77 is a liquid chemical additive which, when added to water emulsion in the amount of 1/10 of one percent and the oil maintained at rest at a temperature of 180 to 185 F, will break the emulsion and all water will settle out in 24 to 48 hr. *Visco* 77 is said to be noncorrosive and harmless to any lubricating oil and may be employed safely on any major circulating system where difficulty is experienced in removing water from the lubricating oil. Product is in 5- and 55-gal containers. **Dept P, Honan-Crane Corp, Lebanon, Ind.**

## Plastic Slide Rule

PLAS-TEN is a professional-grade slide rule with razor-sharp easy-to-read graduations. This 10-in. plastic slide rule comes with a heavy leather case. **Dept P, Frederick Post Co, Box 803, Chicago, Ill.**




## Valves

FIRST OF A NEW LINE of valves for air and hydraulic controls are following three units:

1. Packless ¼-in. capacity valve called Hanna *Unitite Jr,* for tubing and light piping applications, is a smaller model of Hanna's standard *Unitite* valve. Precision-built and permanently tight, it is for 4-way operation, but may be used as a 3-way valve by plugging one port. It is suitable for air, oil or water in pressures up to 250 psi. An 80-deg handle movement gives complete reversal. Valve is for manifold, column or panel mounting.

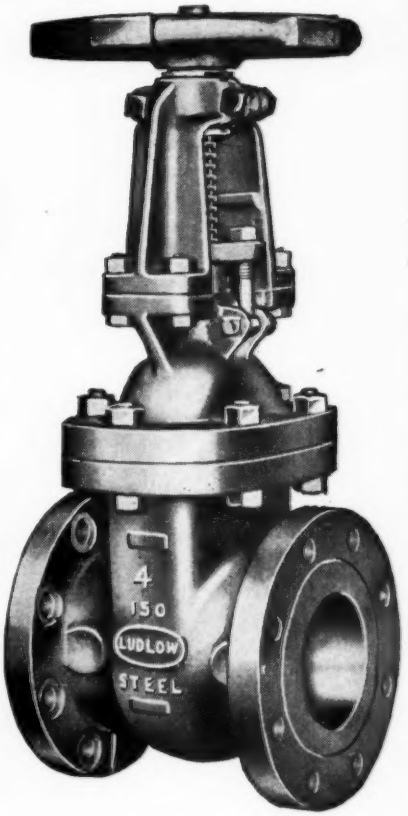
2. New Hanna foot-operated valve that frees hands for other work is a packless control for air and oil hydraulic-cylinder applications. It is made in two styles—one with single pedal for constant cycles of operation, the other with split pedal that holds position until tripped for reversal. Available in ⅜-, ½-, ¾- and 1-in. sizes, it operates on 250-psi air pressure or 1000-psi oil pressure.

3. Hanna 2-direction speed-control valve controls cylinder piston speed in both directions. It provides for adjustable control of inflow and outflow of air or oil inde-


# MODERN
## FROM HANDWHEEL TO FLANGE

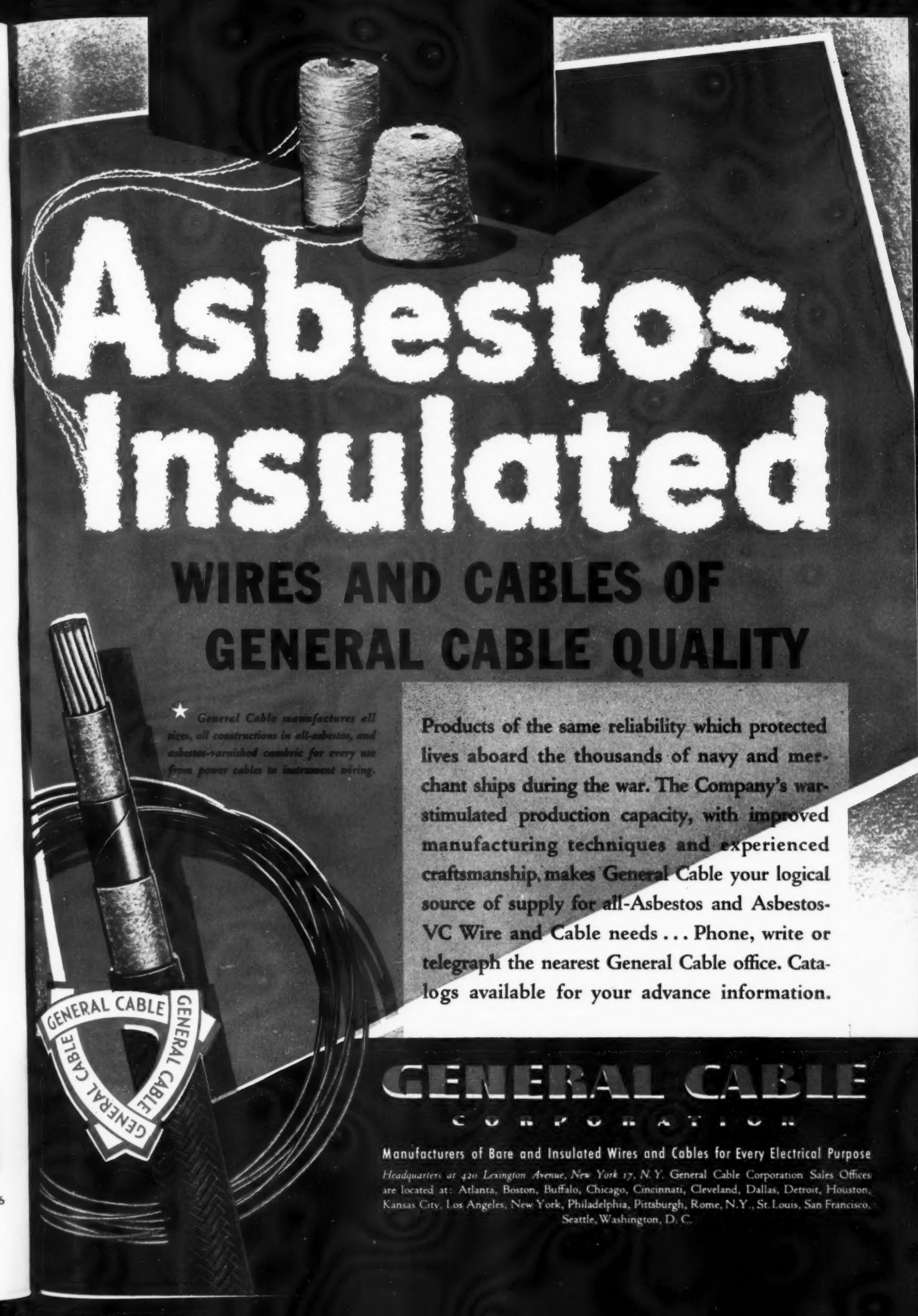
No point of good engineering practice was overlooked in designing the Ludlow Cast Steel Wedge Gate Valve line. The sturdy lugged-rim handwheel which provides a slip-proof grip on the cool rim and the heavy split yoke to take the thrust, with the handy cast lugs for use as a follower shelf during repacking, are but two exterior examples of the superiority of this Ludlow design.

Write for complete Ludlow Valve Catalogs.




Ludlow Cast Steel Wedge Gate Valve. Now made in sizes 4" to 12", 150 lb. series only.

The LUDLOW VALVE MFG·CO·INC· SINCE 1866 TROY·N·Y·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GENERAL CABLE QUALITY
★ General Cable manufactures all sizes, all constructions in all-asbestos, and asbestos-varnished cambric for every use from power cables to instrument wiring.
Products of the same reliability which protected lives aboard the thousands of navy and merchant ships during the war. The Company's war-stimulated production capacity, with improved manufacturing techniques and experienced craftsmanship, makes General Cable your logical source of supply for all-Asbestos and Asbestos-VC Wire and Cable needs . . . Phone, write or telegraph the nearest General Cable office. Catalogs available for your advance information.
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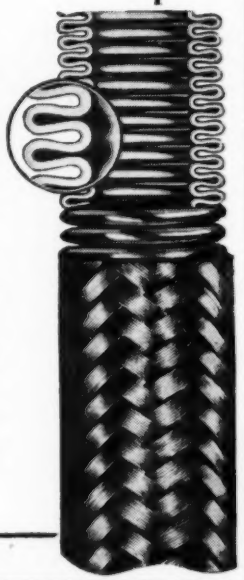
CORPORATION
Manufacturers of Bare and Insulated Wires and Cables for Every Electrical Purpose
Headquarters at 420 Lexington Avenue, New York 17, N.Y. General Cable Corporation Sales Offices are located at: Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Kansas City, Los Angeles, New York, Philadelphia, Pittsburgh, Rome, N.Y., St. Louis, San Francisco, Seattle, Washington, D. C.

REX-WELD

KING OF FLEXIBLE METAL HOSE!

There are reasons for leadership in every line. Better performance, finer quality, greater versatility and dependability . . . these and many more have given REX-WELD Flexible Metal Hose the high reputation it has today. A reputation that has earned the confidence of industry everywhere. Industrial men know the advantages of REX-WELD. For this rugged, seep-proof, airtight product has been outperforming ordinary connections on a wide variety of applications throughout industry.

Let "Flexon," the C. M. H. trademark character, show you in the sketches below some of REX-WELD'S outstanding features. Then ask us to give you the full story about REX-WELD and the other flexible metal hose products in our complete line.



REX-WELD . . . stands up under terrific flexation, vibration and strain. Its heavier, more uniform wall structure gives it greater strength, longer life.

REX-WELD . . . handles steam with utmost safety. It is seep-proof to gas, oil, water and searching fluids. It is highly rust-resistant and non-deteriorating.

REX-WELD . . . operates efficiently under pressures up to 5,000 p.s.i., temperatures to 1000° F. Greater strength and durability are the result of its 50-50 principle of corrugation . . . of an autogenous welding process that makes the weld stronger than the tube itself.

REX-WELD . . . is available in bronze and steel in sizes from 3/16-in. to 4-in. I.D. (incl.), with annular or helical corrugations, braided or unbraided, depending on requirements. REX-TITE heatproof mechanical couplings are easy to install and are reusable.

Flexible Metal Hose for Every Industrial Use

ARMY E NAVY

CMH CHICAGO METAL HOSE CORPORATION

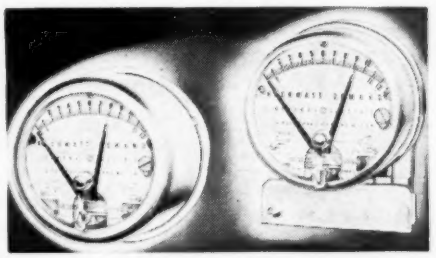
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

pendently to and from one side of piston. One valve is for oil operation, two are recommended for air. Working pressures are 250 psi for air cylinders and 1000 psi for hydraulic. Pipe sizes available are ¼, ⅜, ½, ¾ and 1 in. **Dept P, Hanna Engrg Works, 1765 Elston Ave, Chicago 22, Ill.**

## Shop Truck

BUDA MODEL HB CHORE BOY is a dual-wheel heavy-duty platform truck of one-ton capacity. This *Chore Boy* is the same as Model FF in capacity, dual wheels and rear axle, except that it has a shorter wheelbase, thus carrying the same heavy loads with easier-turning narrower aisles. Also, more traction effort is obtained in Model HB. Equipped with 7.7 air-cooled 4-cycle engine, it is capable of speeds up to 15 miles per hr. It will turn between walls 15 ft apart. Its frame is of electrically welded reinforced steel. Loading space is 12.8 sq. ft. Dimensions are 92-in. over-all length, 32-in. width, 56-in. wheelbase. **Dept. P, Buda Co, Harvey, Ill.**



## Thermal Watt-Demand Meter

HI-1 THERMAL WATT-DEMAND METER operates on direct-heat principle which is based on use of temperature-sensitive bimetallic spirals that act as their own heaters. Meter is housed in a glass case, coated on the inside except for circular front opening, to promote uniform heat distribution within the meter and to aid in reducing negligible effects of variable external temperatures. It has a manually operated reset device, by which black pointer can be turned down to contact red pointer.

The direct-heat principle has also been applied to a true single-phase, kva demand meter. Other models, designed on same principle, are at present in development stage. **Dept P, General Electric Co, Schenectady 5, N. Y.**

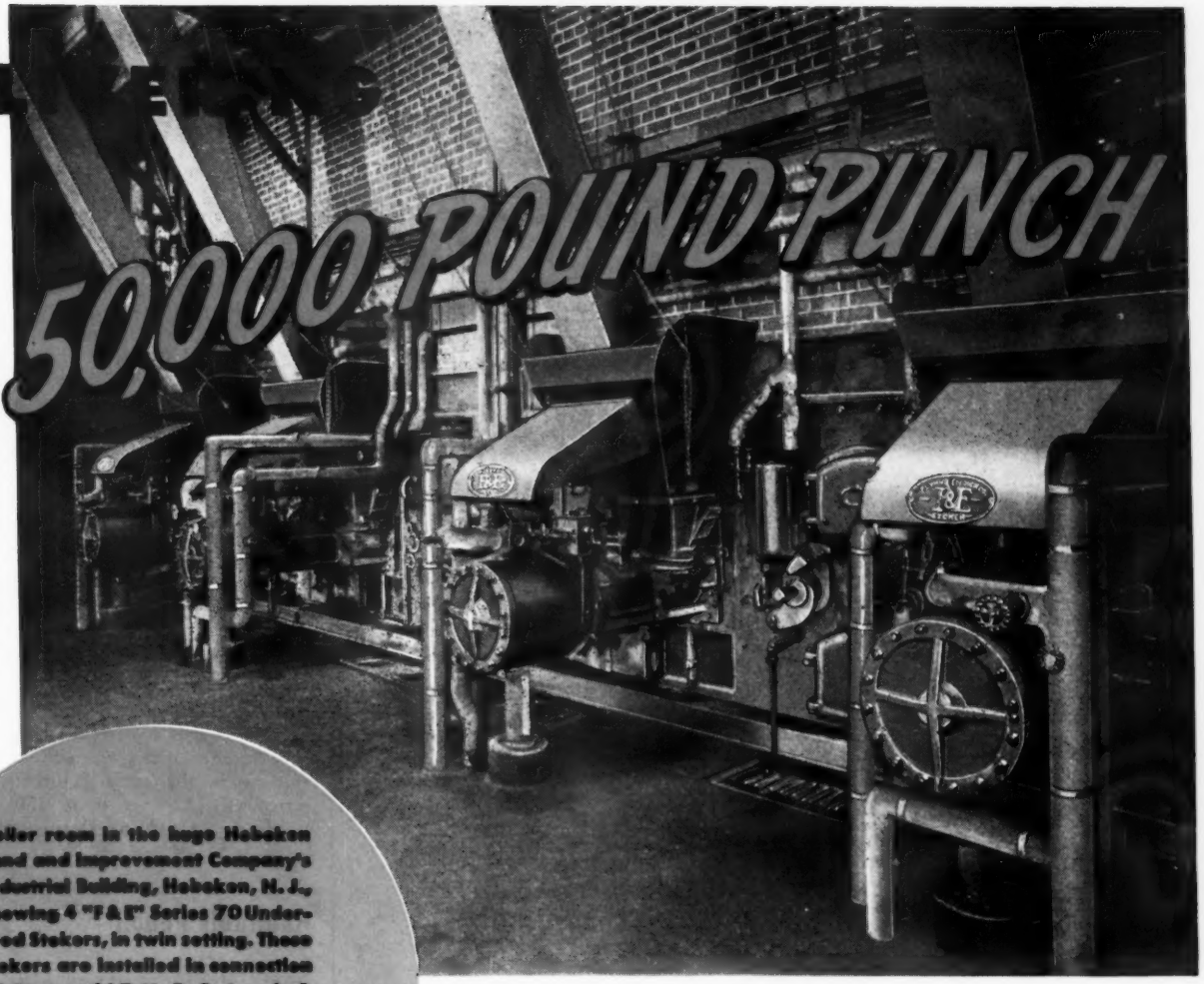
## Silicone Rubber

IMPROVED SILASTIC, a silicone rubber, is flexible at temperatures down to —70 F, according to maker, and resilient at temperatures up to 500 F. *Silastic* stocks now available, when properly cured, have physical and mechanical properties that recommend them for industrial applications in which important factors are thermal stability and oxidation resistance, combined with waterproofness and high-surface resistivity. Their electrical properties make them suitable as an insulating material at normal industrial voltages and frequencies.

*Silastic* may be molded or extruded into any required shape. It may be applied as a

DE

# A 50,000 POUND PUNCH



Boiler room in the huge Hoboken Land and Improvement Company's Industrial Building, Hoboken, N. J., showing 4 "F&E" Series 70 Underfeed Stokers, in twin setting. These stokers are installed in connection with two 687 H. P. Babcock & Wilcox horizontal water tube boilers. They are designed to produce 44,000 lbs. of steam per hour continuously during each day and 50,000 lbs. of steam for two hour peaks.

## DRIVING POWER TO PRODUCTION GOALS!

The concentrated purpose of the "F&E" combination of engineered features is *dependable, trouble-free production of steam power.*

Designed expressly for industrial boilers in plants and large buildings where power controls production, "F&E" Underfeed Stokers, Series 70, are built for rugged service.

Meeting the power demands of continuous daily schedules or peak loads, "F&E" Stokers assure positive control of power production through accurate regulation at all coal feeding and air supply rates. The "F&E" Steam Drive is recognized as a most simple, direct and economical drive. Operating with steam from the boiler direct to the stoker ram, all intermediate driving equipment is eliminated.

See your consulting engineer or local "F&E" Representative who can give you complete details and data on "F&E" Stokers for large and small industrial and commercial uses.

**FLYNN & EMRICH CO.**

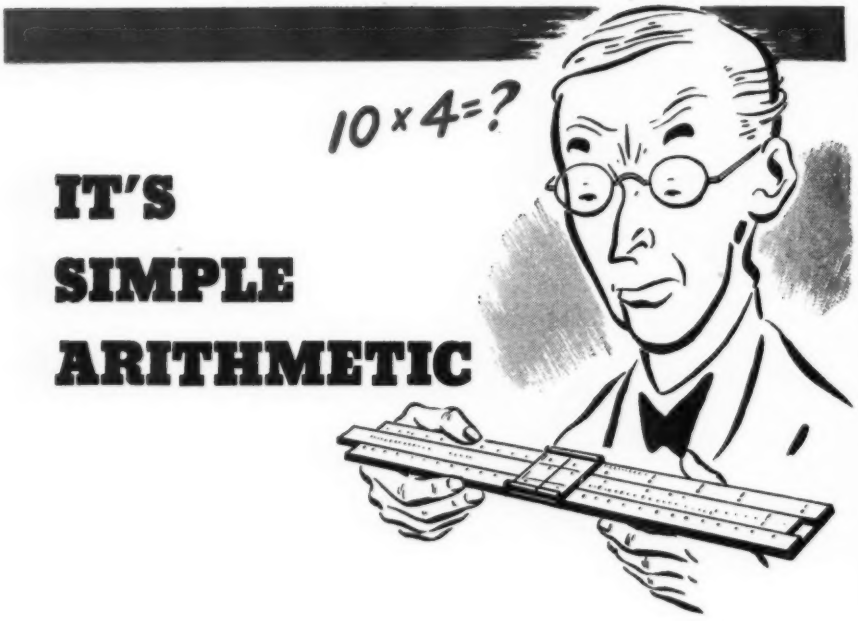
*Established 1842*

HOLLIDAY AND SARATOGA STS., BALTIMORE 2, MD.

*Representatives in Principal Cities*

**F&E UNDERFEED STOKERS**

HYDRAULIC DRIVE AND STEAM DRIVE FOR BOILERS PRODUCING 10,000 TO 50,000 LBS. OF STEAM PER HOUR




**IT'S SIMPLE ARITHMETIC**

You don't have to use calculus to determine how Helicoid Gages can save money. Nor do you have to be a Quiz Kid. It's a question of simple arithmetic.

If your average gage lasts 90 days and the average cost is $10.00, your average cost per year is $40.00 per gage. Since the Helicoid Gage will outlast the ordinary gage about 10 to 1 and the average initial cost is the same, the use of Helicoid Gages will reduce your average cost per year to $4.00 per gage. Your saving in a year is $36.00 per gage, multiplied by the number of gages you use.

These are conservative figures. We have heard of savings of $90.00 per gage in a year when the gage service is really tough. On the basis of using only 100 gages per year, that's a nice saving of $9,000.00.

***SEND FOR THIS CATALOG***

See your nearest distributor. Meanwhile send for our catalog—the only technical catalog published on pressure gages.

ACCO

TRADE MARK

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut


coating for glass cloth, metal or wire. It is useful as an electrical insulating material and is a rubberlike bonding material for fabrication of heat-stable, flexible and waterproof laminations of glass or asbestos cloth. *Silastic* is for many applications where natural or conventional synthetic rubber deteriorates rapidly because of heat or weathering. It also makes possible simplifications in design of equipment and installations which have of necessity been complicated by limited heat and cold resistance of elastic materials previously available.

Now available in commercial quantities are *Silastic* 150, 160, 167 and 180 covering a hardness range of 45 to 85 and designed for molding, sheeting, friction calendering or extruding; and *Silastic* 120 and 125 designed for coating and laminating. **Dept P, Dow Corning Corp, Midland, Mich.**

## Floor Cleaner

OPTIMUS FLOOR CLEANER No. 1F10 is a heavy-duty floor-cleaning compound for cement, *terrazzo* or tile floors. Although effective in removing oil, grease and other dirt from the surface, according to manufacturer, this material does not harm the finish. Optimus floor cleaner is a base from which a liquid floor cleaner may be made, or it may be applied to the surface directly and then rinsed off. Cleaner is in 150- and 500-lb containers. **Optimus Detergents Co, 238 Church St, Matawan, N. J.**

## Refillable Pencil

BRUNING No. 3583 draftsman's refillable pencil incorporates a new clutch that holds lead firmly in a nonslip rubber grip. Knurled grip provides a firm hold and prevents slipping whether held close to or away from point. Pencil holds leads from .079 to .070 in., including degrees HB to 9H drafting lead. **Dept P, Charles Bruning Co, 4745 Montrose Ave, Chicago 41, Ill.**

## Diaphragm Cloth

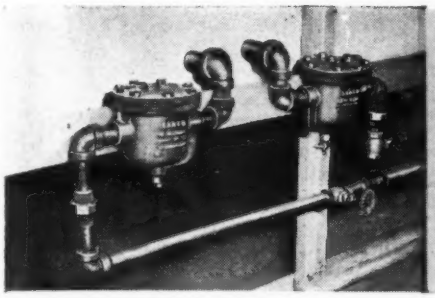
IN ADDITION to good mechanical strength, new 80/80-base Style DL-011 diaphragm cloth retains its flexibility, according to maker, and is practically unaffected by relatively wide temperature changes. Although developed primarily for automotive field, the cloth is recommended for applications where strength, flexibility, operating temperatures and resistance to certain solvents are important considerations. It is available in 100- to 500-yd rolls, 37 in. wide. **Dept P, Irvington Varnish & Insulator Co, 6 Argyle Terrace, Irvington 11, N. J.**

## Linear Potentiometers

LINE OF WIRE-WOUND linear potentiometers, consisting of three models, is said to have exceptionally long life. Electrical angle of rotation is from 352 to 357 deg, leaving a maximum unwound sector of 8 deg in the smallest size and an unwound sector of 3 deg where the maximum wound length is required. It is also claimed to have a torque of less than one-in. oz. **Dept P, Fairchild Camera & Instrument Corp, Jamaica, New York.**

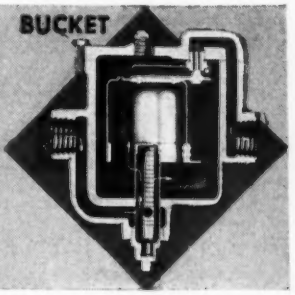
# HOW SARCO SAVES

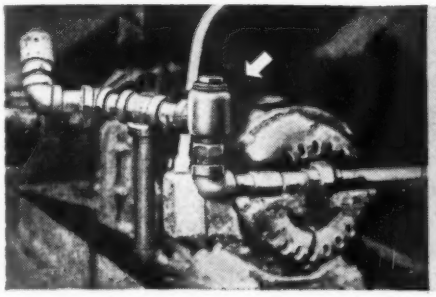
## • • • IN THE CHEMICAL INDUSTRY



### *Drying*

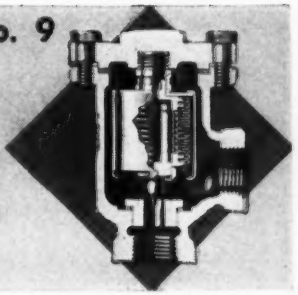
Duck, chemically treated, is passed through a continuous dryer. The Sarco Bucket steam trap keeps the steam coils free from condensate regardless of speed or load. Result: uniform production. Bulletin No. 350.

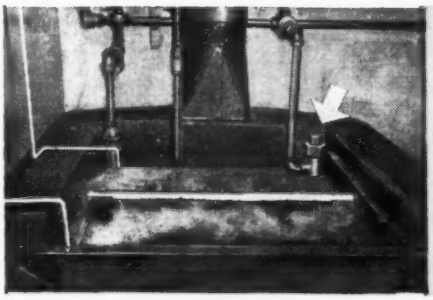


### *Recovery*

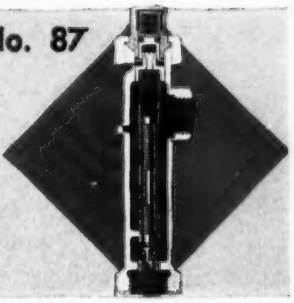
Heat is a large part of the cost of soap. The Sarco No. 9 thermostatic steam trap extracts all usable heat before it opens. A recent improvement has doubled the capacity of this trap. Bulletin No. 250.

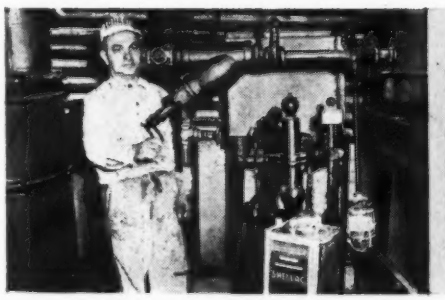


### *Caustic Tanks*

For approximate temperature control, the Sarco No. 87 trap-control acts both as a trap and a temperature regulator. It is inexpensive, reliable and easy to install. Bulletin No. 550.



### *Strainers*

This scraper strainer protects the production of high grade varnish. The purity of syrup, fruit juices and petroleum products is also insured by Sarco Strainers. Self cleaning, hand or motor operated types up to 8" size. Bulletin No. 1200.

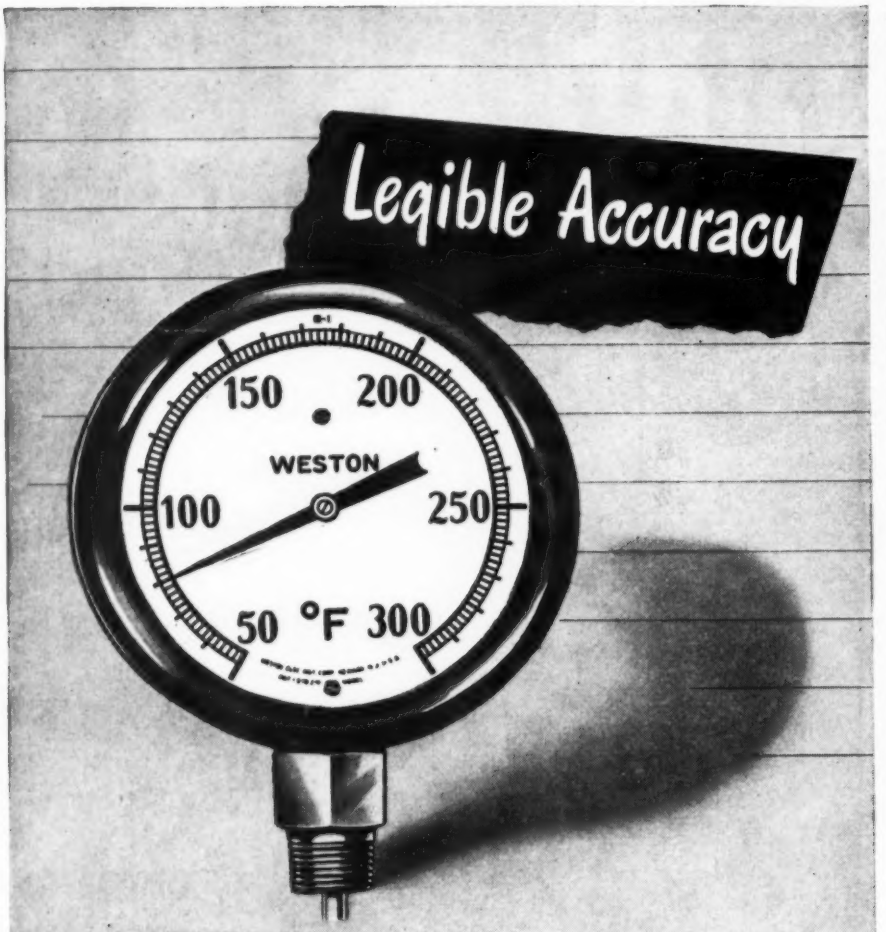
117

FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

# SARCO SAVES STEAM

*Represented in Principal Cities*

SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y. • Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.



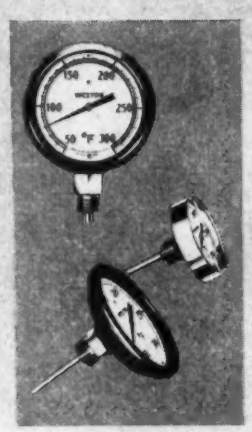

*WESTONS...*

**are easy to read accurately even in difficult locations**

Not only are WESTON thermometers *inherently* accurate over the entire scale, but their gauge-type dials with bold figures and divisions can be *read* easily . . . without error or guesswork . . . even in dim light or when mounted in difficult-to-get-at locations.

Their all-metal construction, too, enables them to *maintain* their dependable accuracy over long periods, despite vibration or subjection to temporary over temperatures. There are no vital parts to break or leak, nothing under pressure.

WESTON thermometers are available in types, sizes and stem lengths for equipment mounting, as well as for all industrial and processing requirements. Ask for Bulletin.



**Weston *All Metal* THERMOMETERS**

**Weston Electrical Instrument Corporation, 679 Frelinghuysen Ave., Newark 5, N. J.**


## Power News

(*Continued from page* 130)

of the government, in cooperation with the Nacional Financeria, a quasi-governmental agency.

The credit may be used at any time before June 30, 1948, and repayment will be made in 40 about-equal semiannual installments. Interest will be 4% yearly. Advances will be secured by assignment of revenues from specified taxes on Mexican energy consumption and by unconditional guaranty of Mexican government.

An advance of $5,000,000 was made to Chilean Development Corp, of which $2,000,000 is for purchase in U. S. of equipment for additional hydroelectric facilities. Remaining $3,000,000 is for projects as yet undetermined. It will be repayable in five years at 4%.

Chilean State Railways were granted a $2,000,000 credit for purchase of electrical equipment, the loans, to be repayable in seven years, at 4%.

Smallest load was a $350,000 credit to Peruvian Companian del Santa. It was extended on application of a U. S. supplier of electrical equipment and is repayable in ten years at not less than 4%.

In addition, the bank has given preliminary authorization in principle to five Chinese credits totaling $33,793,750, of which $8,800,000 is for ten 5000-kw auxiliary steam power plants. These units are to serve as an emergency pool and will replace about one fourth of the power capacity damaged during the war. They will be capable of independent operation or of installation in existing plants. Terms on this portion of the total credit are for repayment in 30 years by semiannual installments over the last 25 years. Interest will be at 3%.

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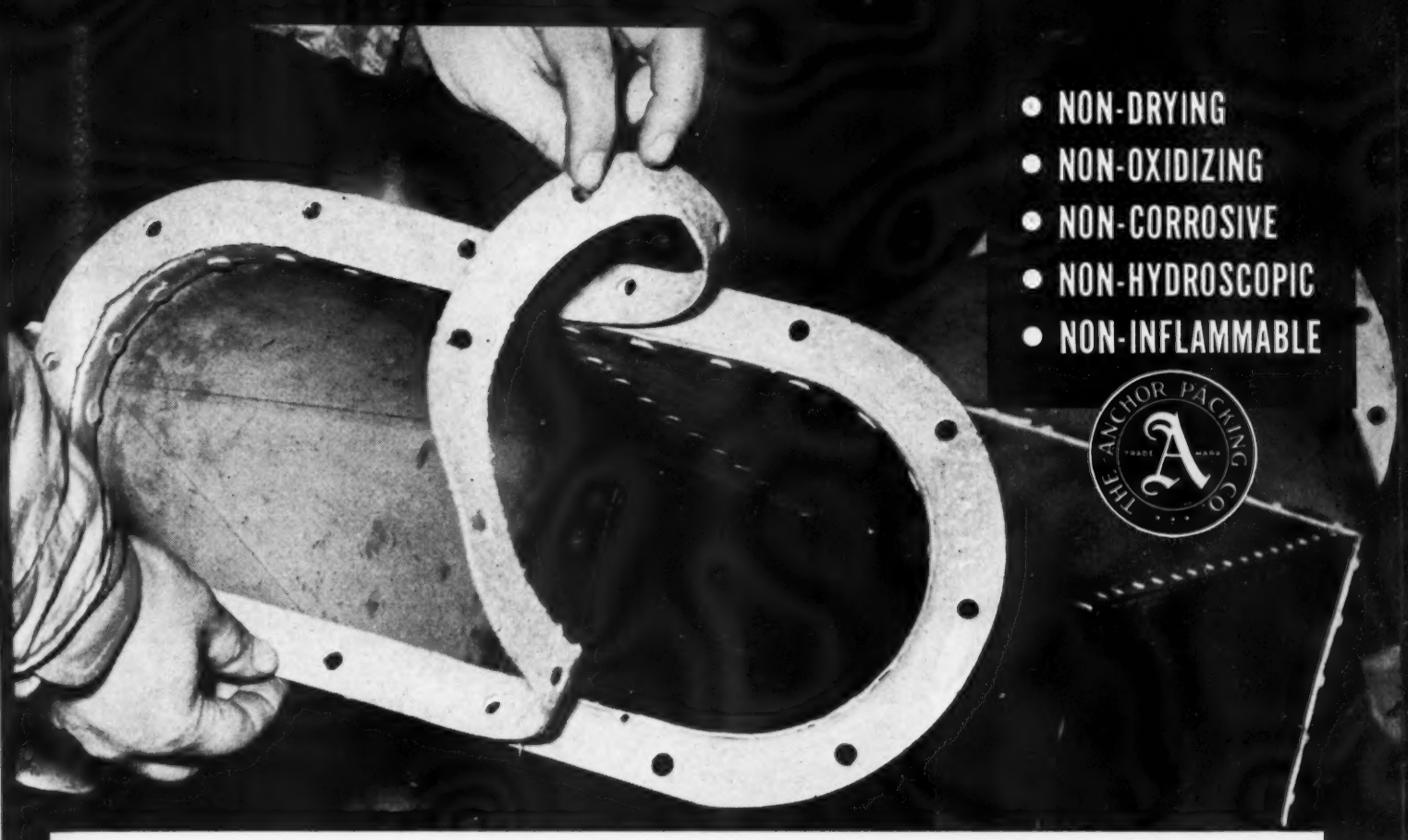
**Release of an official report** by Combined Production and Resources Board now makes it possible for American Standards Association, 70 E 45th St, New York 17, N. Y., to give results of the conference on unification of screw-thread standards held last Oct at Ottawa. This conference was the culmination of months of hard technical effort on part of national engineering committees working through British Standards Institute, Canadian Standards Association and American Standards Association. Agreement was reached that there should be unification of basic screw threads of the three countries. A technical basis was laid for such unification. Report that came out of the conference consists essentially of recommendations to industries of the three countries as to how they may carry out work of unification through their respective national standardizing bodies.




*SHERWIN-WILLIAMS*

# CHROMATE GASKETING

## SOLELY DISTRIBUTED BY THE ANCHOR PACKING COMPANY

Wherever airtight, oiltight, and watertight joining is necessary, specify the revolutionary war-developed Chromate Gasketing. Pioneered by Sherwin-Williams for the Navy and Maritime Commission, Chromate Gasketing is a *special* wool felt impregnated with plastic material. In ventilating, plumbing, fuel oil and diesel oil systems, it proved itself under the merciless conditions of war.

### HUNDREDS OF APPROVED USES

- Drainage systems
- Fire mains
- Fresh water lines
- Flushing systems
- Sprinkling systems
- Plumbing drains
- Fuel and Diesel oil systems
- Vent trunks, duct joints
- All piping except steam
- Electrical installations

### CHROMATE GASKETING IS BETTER BECAUSE:

**1.** Resists shock, does not oxidize. **2.** Oil and cleaning solvents do not affect. **3.** High heat resistance, up to 200°F. **4.** Free from toxic odors. **5.** Non-oxidizing, excellent adhesion. **6.** Non-inflammable, fire retardant. **7.** Chromate in gasketing is rust inhibitor. **8.** Easily punched, cut, drilled. **9.** Maintains air pressure of 25 lbs. sq. in. **10.** Prevents electrolytic action between dissimilar metals.

## THE ANCHOR PACKING COMPANY

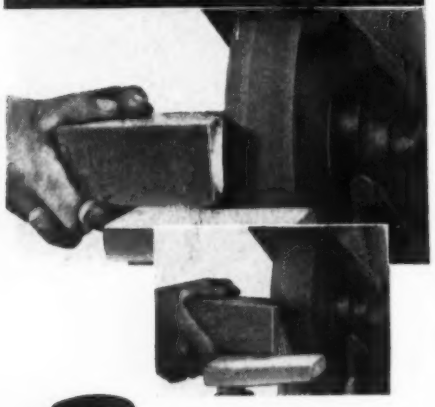
GENERAL OFFICES: PHILADELPHIA 8, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

### BRANCH OFFICES

| | | | |
|---|---|---|---|
| Baltimore 2, Maryland | 106 Stewart Bldg., Gay and Lombard Streets | Montreal 20, Canada | 5575 Cote Saint Paul Road |
| Boston 14, Massachusetts | 303-04 North Station Building 150 Causeway Street | Milwaukee 2, Wisconsin | 903 East Kilbourn Avenue |
| Buffalo 2, New York | Andrews Building | New Orleans 4, Louisiana | 418 Common Street |
| Cleveland 13, Ohio | 523-25-27 Rockefeller Building | New York 13, New York | 100 Sixth Avenue, near Canal |
| Columbus 9, Ohio | 172 North Cassingham Road | Philadelphia 8, Pennsylvania | 401 North Broad Street |
| Chicago 11, Illinois | 230 East Ohio Street | Pittsburgh 22, Pennsylvania | 405 Penn Avenue |
| Cincinnati 2, Ohio | 4 West 7th Street | Portland 1, Oregon | 1433 S. W. Front Avenue |
| Detroit 26, Michigan | 169 West Jefferson Avenue | San Francisco 7, California | 156 South Park |
| Houston 2, Texas | 509 Washington Avenue | Seattle 4, Washington | 2207 First Avenue, South |
| Kansas City 6, Missouri | 1332 Oak Street | St. Louis 3, Missouri | 1407 Pine Street |
| Los Angeles 21, California | 720 Mateo Street | Tulsa 4, Oklahoma | 823 South Gary Place |
| | | Wilmington, California | 524 North Avalon Boulevard |

# BRICKSEAL
## REFRACTORY COATING



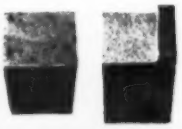
*Resists*

## ABRASION

PROTECTION against abrasion is an outstanding advantage of Brickseal. Here are two refractory bricks, one coated with Brickseal, the other uncoated. They were heated to more than 2000°, taken directly from the furnace, cooled and shoved against an emery wheel. Hot and cold, the Brickseal-treated brick resisted the abrasion – see below.

Brickseal consists of high fusion clays and metal oxides combined in oil. Furnace heat burns away the oils and vitrifies the clays and metals which penetrate deeply into the pores, cracks and joints. Brickseal prevents cracking, spalling and slagging regardless of sudden temperature changes. Brickseal is also a mortar for laying up refractory walls.

*Compare the Brickseal-treated brick at the left to the untreated at the right.*



## TRY IT YOURSELF

*Two bricks bonded together and partially coated with Brickseal will be mailed to you on request.*

**BRICKSEAL**
**REFRACTORY COATING**
5800 So. Hoover St., Los Angeles, Calif.
1029 Clinton St., Hoboken, New Jersey


## U. S. Offers War Plants For Purchase or Lease

War Assets Corp offers following plants for sale or lease:

(1) Two war plants up for sale or lease contain a total of 24,000 kw of generating capacity in four units. One is at Ludington, Mich., where it was operated by Dow Magnesium Corp. Its equipment includes two 6000-kw turbine-generators, which exhaust to process steam lines. The units are served by two 225,000-lb-per-hr pulverized-coal boilers. Installation is described as "definitely designed for use in a manufacturing process." Ludington plant is identified as Plancor No. 477. The other plant is at Baton Rouge, La., where it was operated by Aluminum Ore Co, an Alcoa subsidiary. Its equipment includes two 6000-kw 110-psi backpressure turbines served by three 140,000-lb-per-hr gas-fired boilers. The power plant was built to operate as an integral part of the general alumina system. Steam from the turbines exhausts direct for process use. Power plant is described as inefficient for independent use. Baton Rouge plant is designated Plancor No. 226-AO.

(2) Two war plants are offered in which electric-generating capacity was installed. One plant, operated by Dow Chemical Co at Freeport, Tex., contained a 20,000-kw condensing steam turbine and a 250,000-lb-per-hr gas-fired boiler. Unit is part of a larger power station owned by Dow with various of its boiler and generator auxiliaries part of main station. Identification of Freeport plant is Plancor No. 81. Also for sale or lease is a plant at Baytown, Tex., operated during the war by Humble Oil and Refining Co. Its power plant includes one 4000- and one 5000-kw full-condensing steam turbine and eighteen 30,000-lb-per-hr gas-fired boilers. Generators are 30 years old and boilers 30 to 40 years, approved for war-emergency use. Baytown plant is designated Plancor No. 1082.

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**American Society of Lubrication Engineers** presented 13 technical papers on the art and science of lubrication at the meeting on April 5-6 in the Stevens Hotel, Chicago. This was the first national meeting of the ASLE. Founded Oct, 1944, this young and growing society had previously encountered the wartime convention ban.

New president of the ASLE is Dr E M Kipp of the Aluminum Co of America. Prof B H Jennings of Northwestern University, Evanston, Ill., was re-elected secretary-treasurer. Prof Jennings is also editor of the ASLE official journal, *Lubrication Engineering*, published at 1008 Times Star Bldg, Cincinnati 2, O.

Society membership is 550. Attendance at the convention was over 300.

**Steel in the War,** published by United States Steel Corp, assembles facts and figures which measure importance to national security of this basic metal. It traces development of many new steels and new uses of steel that were invaluable to our armed forces and our Allies and are now available for postwar needs. This book has been made available to libraries as an industrial reference volume.

Type DA-31 Pressure Control

**MERCURY SWITCH**
Hermetically sealed mercury switch is used. They cannot be affected by dust, dirt or corrosion; nor are they subject to open arcing, oxidation, pitting or sticking of contacts, all common causes of contact trouble. This switch will give better control service and longer control life.

**BOURDON TUBE**
(Hidden back of cover)
The Bourdon tube is the actuating element of the control. It is the oldest known, tried and proven element, having been used in gauges for many years.

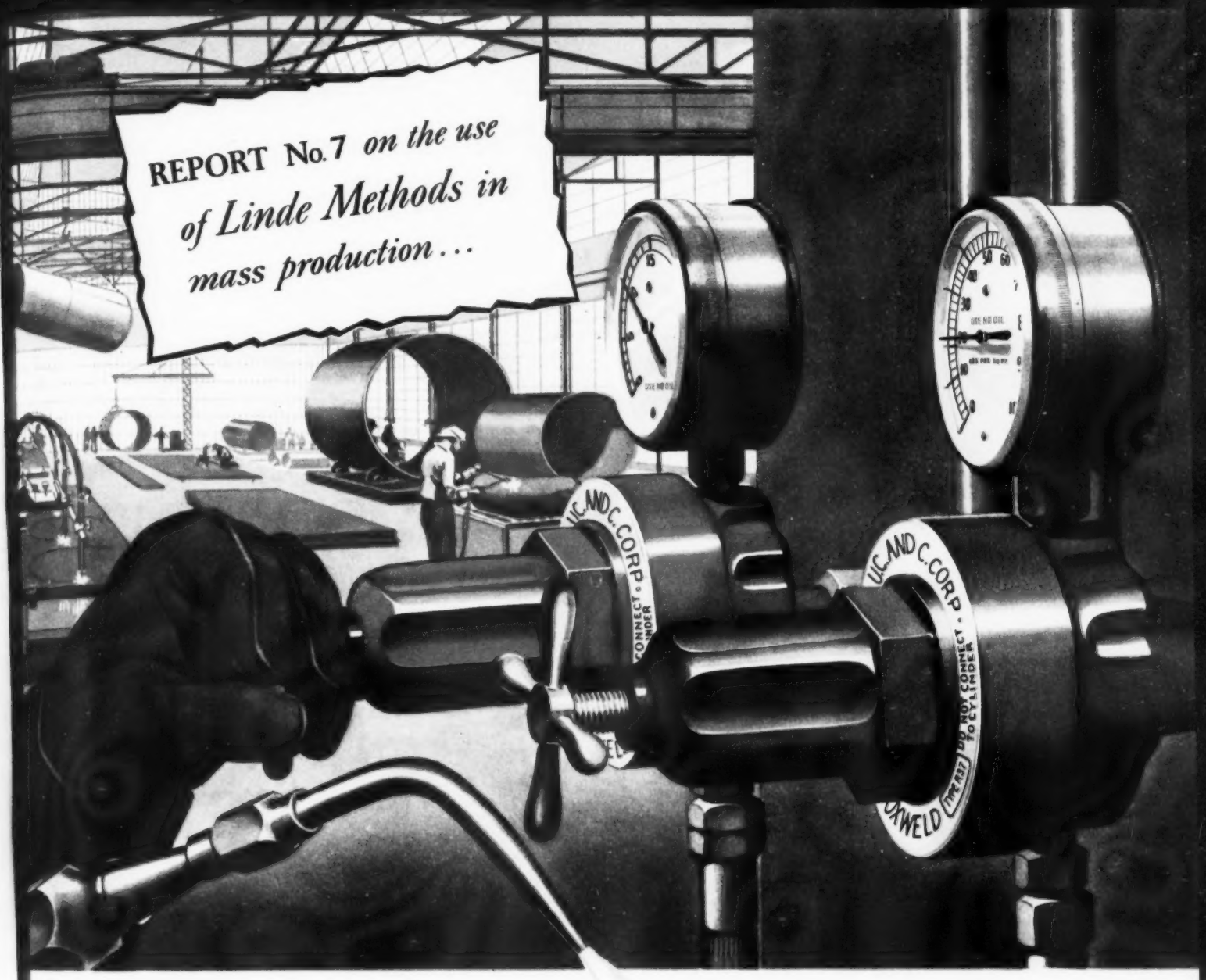
**OUTSIDE ADJUSTMENT**
The outside double adjustment with the calibrated dial and pointers is a convenient feature, making it very easy to set the required operating range, plainly visible on the dial. All guesswork is eliminated.

**GLASS FACE**
The glass face on the cover permits seeing the entire operation of the control in plain view. One can always tell whether the switch circuit is open or closed, a great convenience whenever servicing becomes necessary.

Consult Mercoid on pressure, temperature, liquid level or automatic mechanical control problems.

**THE MERCOID CORPORATION**
**4201 Belmont Avenue**
**Chicago 41, Illinois**

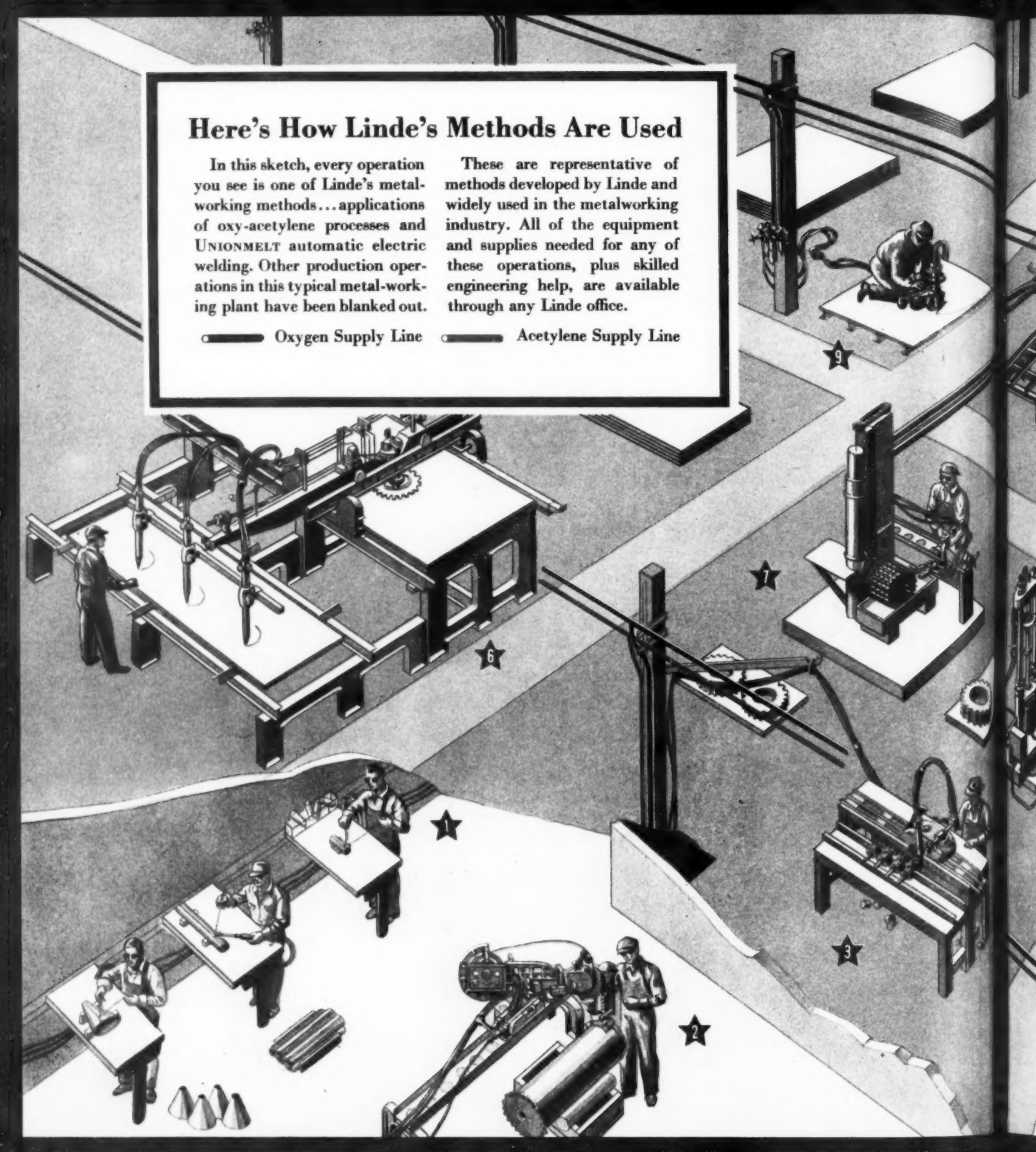
THE ASSURANCE OF
DEPENDABLE SERVICE
BUILT IN EVERY
MERCOID CONTROL



## In METAL-WORKING PLANTS LINDE METHODS are Important in Many Steps of Manufacture

A continuous succession of Linde developments for oxy-acetylene flame-joining, cutting, forming, and treating metals has changed fabrication methods so much that in many metalworking plants oxygen and acetylene are now made as readily available as water and electric power. Equipment can be connected to the supply line anywhere by means of convenient outlets, such as you see above.

In the sketch that you will see as you turn this page, are shown some of the many uses of the intensely hot oxy-acetylene flame in the production line. One of these—marked 8—is a relatively new one.



## Here's How Linde's Methods Are Used

In this sketch, every operation you see is one of Linde's metal-working methods... applications of oxy-acetylene processes and UNIONMELT automatic electric welding. Other production operations in this typical metal-working plant have been blanked out.

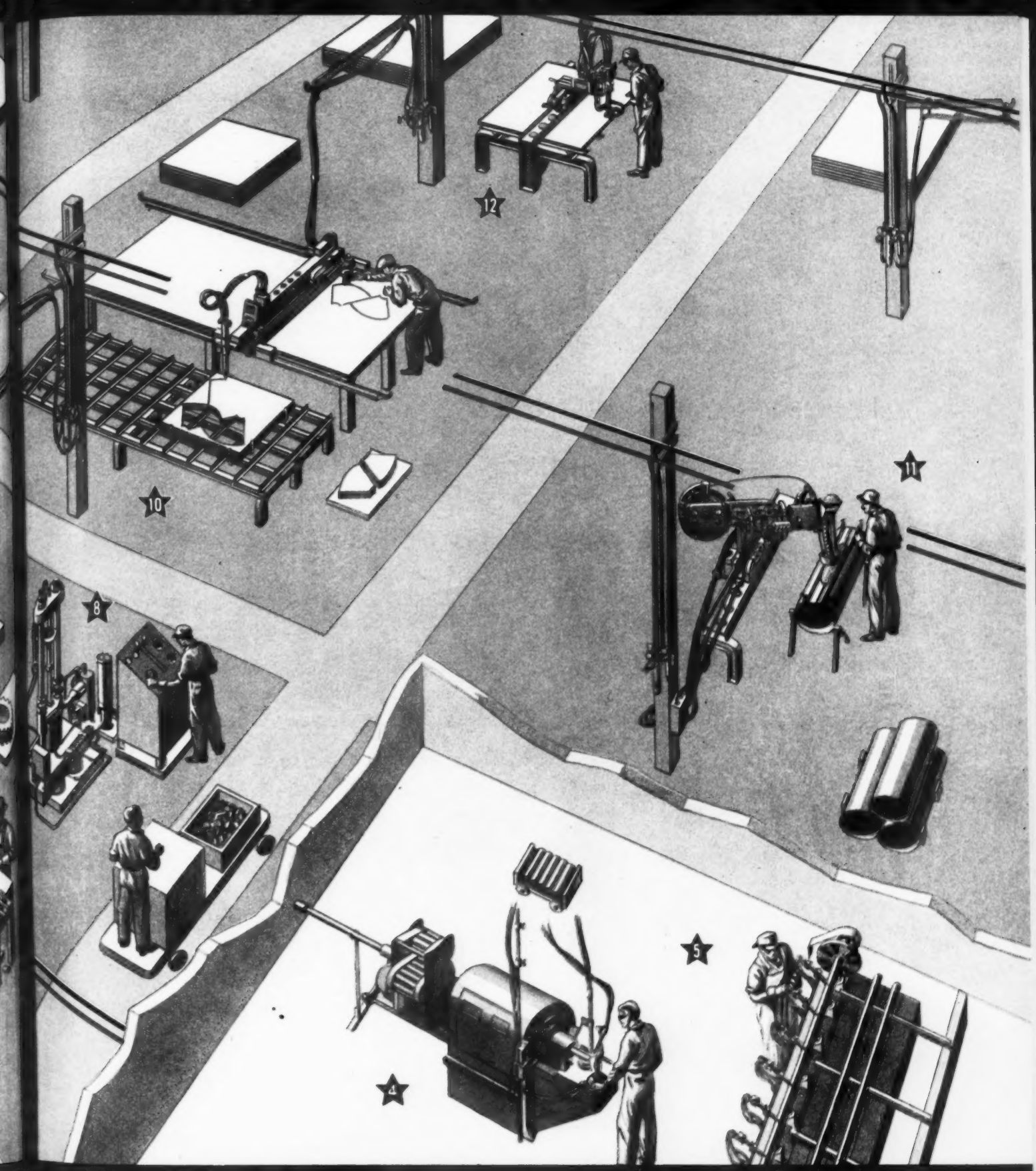
These are representative of methods developed by Linde and widely used in the metalworking industry. All of the equipment and supplies needed for any of these operations, plus skilled engineering help, are available through any Linde office.

Oxygen Supply Line

Acetylene Supply Line

## Methods developed by THE LINDE AIR PRODUCTS COMPANY

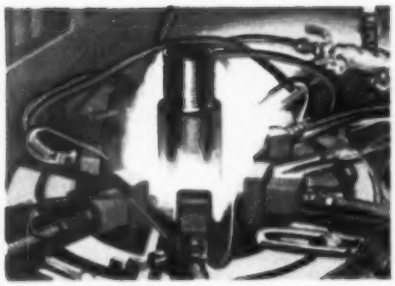
1. Manual welding of small assemblies.
2. UNIONMELT welding of sprockets to drum ends.
3. Flame-cutting risers from cast gear blanks.
4. Flame-spinning of tubing to form end closures.
5. Flame-cutting tubing ready for spinning.
6. Shape-cutting three sprockets simultaneously.



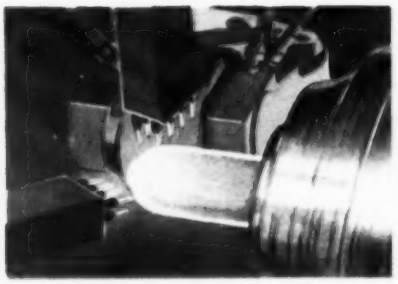

# Simplify the Production of Metal Products of Many Kinds

- Flame-hardening to lengthen sprocket life.
- Pressure-welding bearing sections to shaft.
- Cutting drum heads with a portable flame machine.
- Flame-cutting parts from stacked plate.
- Welding the seam by the UNIONMELT electric process.
- Flame-planing plate edges to be welded.

# WHAT LINDE FLAME METHODS WILL DO

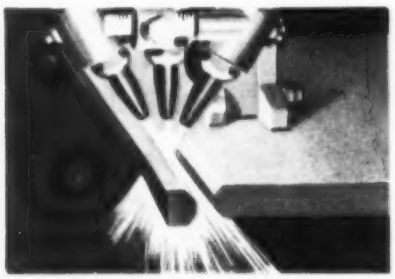


**A hard, wear-resistant case** can be given to local surfaces of hardenable steel by oxy-acetylene flames followed by a water quench. Chemical composition of the metal and toughness of the core are not affected.

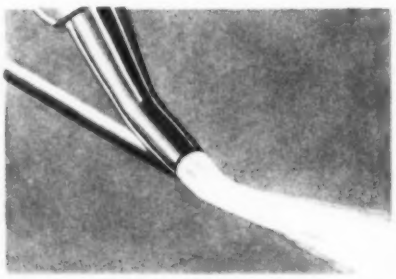


**End-forming of tubular products,** for completely or partially closing the ends, or for reducing diameters at any point, can be done without interruption by applying oxy-acetylene flames to rapidly spinning tubes.

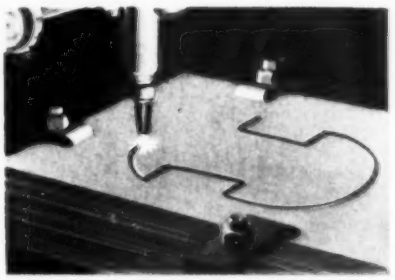
**Smooth - sweep bends** in pipe of almost any diameter and at any angle can be made without thinning the pipe walls or impeding flow, by applying the intense, fully controlled heat of oxy-acetylene flames.



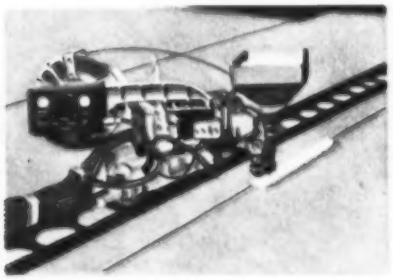
**Preparing plate edges** with flame-cutting equipment speeds trimming and beveling of plate preparatory to welded fabrication. Cuts in several planes can be made simultaneously, accurately, and at low cost and power consumption.



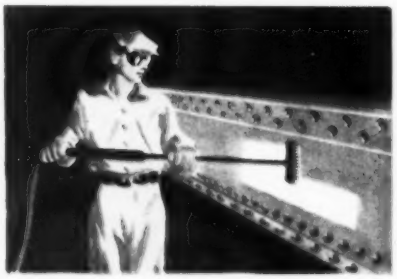
**Grooving of metal surfaces,** the preparation of plate edges for welded fabrication, the removal of temporary welds, and the preparation of cracks in castings for repair by welding are done easily with oxy-acetylene flame-gouging.



**Parts of any size, shape,** or thickness can be fashioned from stock steel plate quickly and accurately with flame-cutting machines. Flame-cut edges are smooth...frequently require no machining.



**Automatic electric welding** by the UNIONMELT process makes high-quality welds in steel of any thickness at speeds up to 20 times faster than other methods of welding with rods.



**Oxy-acetylene flames remove scale,** rust, grease, corrosive salts, and moisture from surfaces of steel prior to painting. Paint goes on faster, bonds tighter, lasts longer.

**Pressure plus heat** from oxy-acetylene flames applied simultaneously, quickly joins plate, pipe, shafting, railroad rails, and metal sections of the same or different metallurgical characteristics.

## THE LINDE AIR PRODUCTS COMPANY

*Unit of Union Carbide and Carbon Corporation*

**30 E. 42nd St., New York 17, N. Y.** UCC **Offices in Other Principal Cities**

**In Canada: Dominion Oxygen Company, Limited, Toronto**

The words "Linde" and "Unionmelt" are trade-marks of Union Carbide and Carbon Corporation or its units.

Other reports on the use of Linde methods in SHIPBUILDING, in STEELMAKING, METAL-FABRICATING, PIPE, PRODUCTION AND FABRICATION OF STEEL, and UNIONMELT WELDING will be sent on request.

# Here's why

*With the finest modern microscope Chase metallurgist checks uniformity and grain size of Chase Antimonial Admiralty condenser tubes.*

## CHASE ANTIMONIAL ADMIRALTY*

***helps reduce annual replacement cost of condenser tubes . . .***

YOU get longer service life from condenser tubes made with Antimonial Admiralty. The power engineer can appreciate what a saving this represents in annual tube replacements.

Millions of pounds of Antimonial Admiralty have been installed since Chase developed it in 1935. That's because of the remarkable resistance of this patented Chase copper alloy to dezincification.

You would expect to pay more, most likely, for a condenser tube of such quality. Actually, the initial cost of Chase Antimonial Admiralty tubes is no greater than for plain Admiralty. For information phone the nearest Chase Warehouse or Service Office.

*U. S. Pat. No. 2,061,931

CHASE

Special Stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses at LOS ANGELES NEW ORLEANS SAN FRANCISCO

also carried by— Vinson Supply Co., TULSA Standard Brass & Mfg. Co HOUSTON

## CHASE BRASS & COPPER CO.

—Incorporated—
*Waterbury 91, Connecticut*
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO† CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO.† LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON†

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*This is the Chase Network—handiest way to buy brass*

Extra STRENGTH for Heavy Duty

KEWANEE

• Extra stout stays and braces add further strength to the sturdy steel construction.

**10 to 304 H.P.**

**100, 125, 150 lbs. W. P.**

Has all the characteristics which make firebox boilers especially adapted for high pressure.

WON FOR 5th TIME

*75 Years Boilermakers*

*For 6" scale with pipe diameter markings... WRITE Dept. 96-K5*

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

THE PACKING for EVERY PURPOSE

*Stops Leaks* *Prevents Scoring*

**ALLPAX**

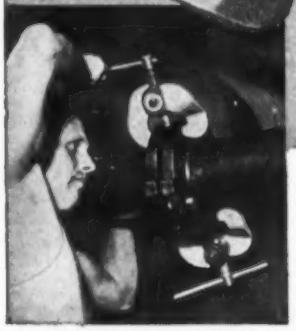
This universal packing — consisting of long, tough fibrous asbestos fibres, thin flakes of anti-friction metal, minute graphite scales and a heat-proof lubricant — is recommended for general service against steam, water, air, ammonia, oils, gases, etc. where temperatures do not exceed 600°F. Fits all sizes and shapes of stuffing boxes. Special styles available for high temperature and corrosive liquids, for products, etc. Try it and you'll use it regularly.

*Distributors everywhere*

THE ALLPAX CO., INC., MAMARONECK, N. Y.

**FLANGE JACKS**

...eliminate costly gasket replacement shut-downs!



An ingenious tool for opening pipe flanges for gasket renewal — quickly, easily and safely. FLANGE JACKS eliminate hazardous hammer and chisel methods and prevent damage to flange faces. Openings are smoothly made against great pressures, yet flanges are held in perfect alignment. FLANGE JACKS save time, reduce accidents . . . make *better* seals possible.

**WRITE FOR LITERATURE**

WRITE DEPT. E. FOR DETAILS OR SEE YOUR NEAREST DISTRIBUTOR.

**MAXIMUM PROTECTION**

**to personnel and plant!**

FLANGE JACKS are vital when replacing gaskets in presence of oil or gas fumes . . . eliminates hammer blows and sparks. FLANGE JACKS are a "must" in safety engineer specifications.

**T. G. PERSSON COMPANY**

224 GLENWOOD AVE., BLOOMFIELD, NEW JERSEY

## SPA Evaluates Surplus Electrical Equipment

Federal purchases of electrical machinery and equipment during the war totaled $8,300,000,000, of which less than 0.7% had been declared surplus last Nov 30, the Surplus Property Administration reported to Congress recently. SPA asserted that "it is not expected that large amounts of heavy equipment suitable for central power stations, industrial power plants and marine propulsion will appear as surplus," and added that "many plant installations will not be put on the market except with the plant itself."

Declaration of small generator sets, gasoline and diesel driven, account for $20,000,000 of the $56,000,000 worth of electrical machinery and equipment that had been declared surplus as of last Nov 30. Many of these units went overseas and will not be returned, the report stated, adding that "on the whole, the market for generator sets is good at the present time."

Power and distribution transformers valued at $2,300,000 have been declared surplus and have moved more rapidly than other electrical equipment. Some special designs for odd voltages are being sold to foreign governments and can be modified for domestic needs.

Up to last Nov 30, $16,900,000 worth of insulated wire and cable had been declared surplus, according to the report, which noted that "there is a good market for rubber-covered and weatherproof types and for magnet wire." One of the problems is the existence of large amounts of cable made to U. S. and British Navy specifications for shipboard application. No present Navy use exists and commercial applications for it are limited.

Commenting on disposal methods for electrical machinery and equipment, the report disclosed that the predominant method at present is direct sale to priority claimants and general public. For bulk items, sale through dealers is also widely employed, either by negotiation or bid, or on a fixed-price basis. In the latter case, where items are long in supply, a discount may be offered to dealers. It is probable that prompt and wide distribution may be facilitated by additional methods, such as sale through agents or approved brokers upon a commission basis.

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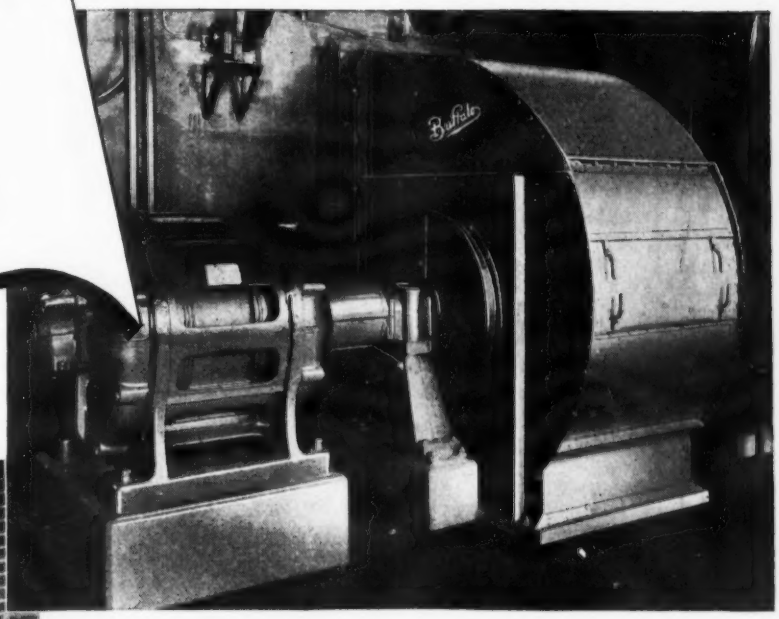
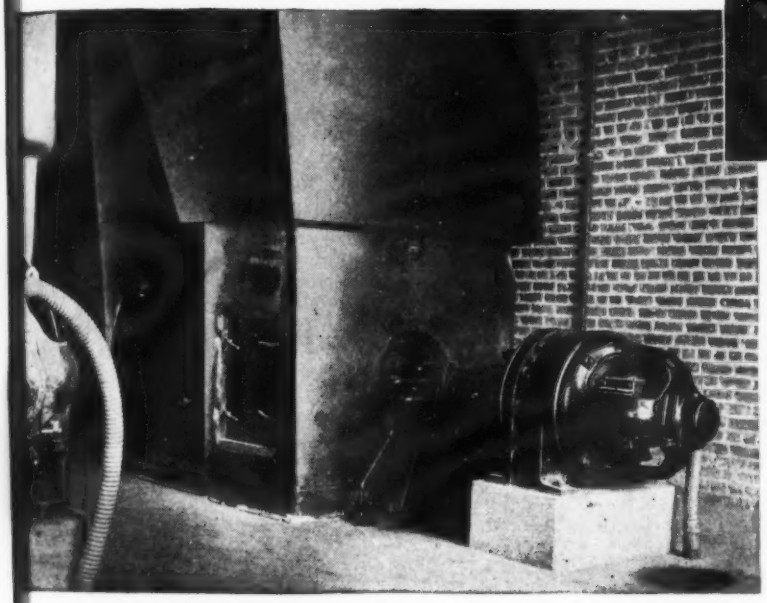
**Washington Award** in recognition of devoted unselfish and pre-eminent service in advancement of human progress was conferred upon Dr Vannevar Bush, administrator, electrical engineer, president of Carnegie Institution of Washington, by the Western Society of Engineers on Feb 20, at the Palmer House, Chicago, for his research activities which have contributed to the well-being of humanity by producing devices and instrumentalities of war that have hastened termination of hostilities.

**Mid-American Exposition,** a gigantic industrial exposition, is scheduled for May 23-June 2 at Cleveland, O. Public Hall and all exhibition halls will be turned into a massive show window where a display of postwar commercial and home products will be spotlighted during the 11-day showing.

# POWER COSTS again have a meaning



Since 1941, it really hasn't mattered about power costs—since the main concern has been to keep going.

In 1946, and from now on, power costs as a part of manufacturing costs, are going to be important.

That's why it will pay to get all the information on Buffalo Draft Fans when you select such equipment.

You'll find that the correct design of Buffalo Fans means high efficiency. Moderate speed means long life. Oversize construction of many parts means freedom from breakdown.

And—you'll find proof of these statements in the operating records of Buffalo users. *Write for Bulletins.*

**BUFFALO FORGE COMPANY**

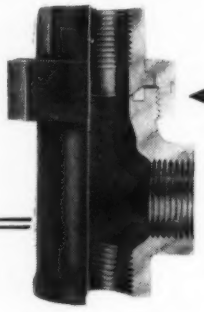
488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

# MECHANICAL DRAFT APPARATUS

# JEFFERSON
## *Specialty*
# UNIONS



with the RECESSED BRASS SEAT

Jefferson All-Female Union Tee with a union on the run.

## Simplify Unusual Piping Problems

Wherever a union is desired near a tee, the use of a JEFFERSON UNION TEE will assure easier piping installation, a better job, fewer pipe joints and a permanently tight connection.

ALL JEFFERSON Specialty Unions feature the exclusive Recessed Brass Seat. This design provides a brass to iron joint which in effect is a one-piece construction. True machining and precision grinding result in a leak-proof union rather than a jam joint. While this insurance against leakage costs more to produce, it pays high returns in better all-round service.

If you are looking for unions that can be depended on to give years of carefree service, investigate "Jefferson", the Union that does a better job wherever it is used. Full details can be had from your nearest distributor . . . or write us direct.

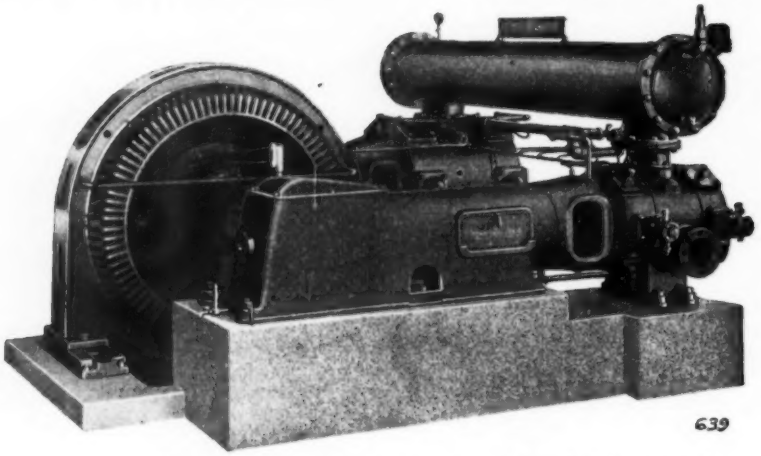
## JEFFERSON UNION CO.

**601 West 26th St., New York 1, N. Y.**

**LEXINGTON 73, MASS.** **LOCKPORT, N. Y.**



# *ENDURING SERVICE*



639

For economy of operation and maintenance; for dependable performance in continuous heavy duty service over long periods, PENNSYLVANIA duplex, direct connected, synchronous motor driven compressors of the type illustrated have earned the endorsement of industry wherever installed.

*Please send for descriptive Bulletin No. 192*

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PENNSYLVANIA PUMP & COMPRESSOR CO.

BUSHKILL PARK ROAD, EASTON, PENNA.

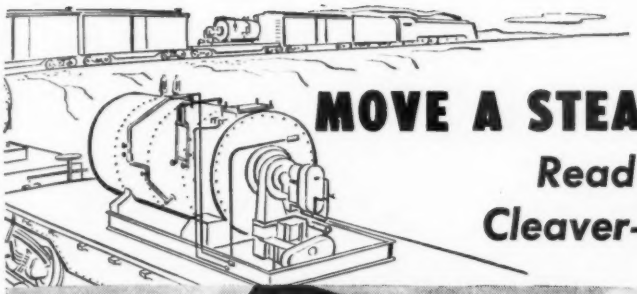

**Booklet, entitled** *Recommended Rules for Repairs by Fusion Welding to Power Boilers and Unfired Pressure Vessels* is available on request to National Board of Boiler & Pressure Inspectors, 145 N High St, Columbus 15, O. Publication includes following chapters: (1) No Repairs by Welding Without Inspector's Approval (2) Rules for Welding (3) Cracks—Permissible Welded Repairs (4) Building Up of Corroded Surfaces (5) Seal Welding (6) Re-ending and Piecing Tubes (7) Patches, Unstayed Sheets (8) Patches, Stayed Sheets (9) Patches, Tube Sheets, Fire-Tube Boilers, Repair of Tube Holes (10) Appendix I—Test to Determine Competency of Qualified Welder (11) Appendix II—Test to Demonstrate Ability to Operate Welding Equipment (12) Appendix III—Record of Qualification Test of Welding Procedures and Operators (13) Appendix IV—Record of Qualification Test of an Approved Welding Operator (14) Appendix V—Record of Welded Repairs.

**Public Domain** is a new weekly publication. Each issue of this service will be a 250-page reference book containing over 1000 patents, which will expire four weeks after date of issue and which will then be open to exploitation by whoever cares to use them. Each patent featured includes a good reproduction of a draftsman's drawing together with a digest of typical claims and salient features. First regular issue appears in May and thereafter every week. Published by Scientific Development Corp, 614 W 49th St, New York 19, N. Y., charter subscriptions are offered for one year at $45, six months at $25, and 10 weeks at $10.

**American Welding Society** now has available in pamphlet form reprints of Adams lectures presented at 25th and 26th annual meetings. Each year an award is made to an outstanding scientist or engineer whose lecture presents some new and distinctive development in the welding field. A 22-page pamphlet, entitled *Solid Phase Welding*, by Dr Augustus B Kinzel, is an outstanding analysis of principles and theory of pressure welding and solid-phase bonding. A 10-page publication, *Selection of Steel for Welding*, by Dr Samuel L Hoyt, explains why steel selected for welding should be chosen for "welding quality," which includes weldability and also the qualities needed for service after fabrication. Copies of these pamphlets are available from American Welding Society, 33 W 39th St, New York 18, N. Y., at 50¢ per copy.

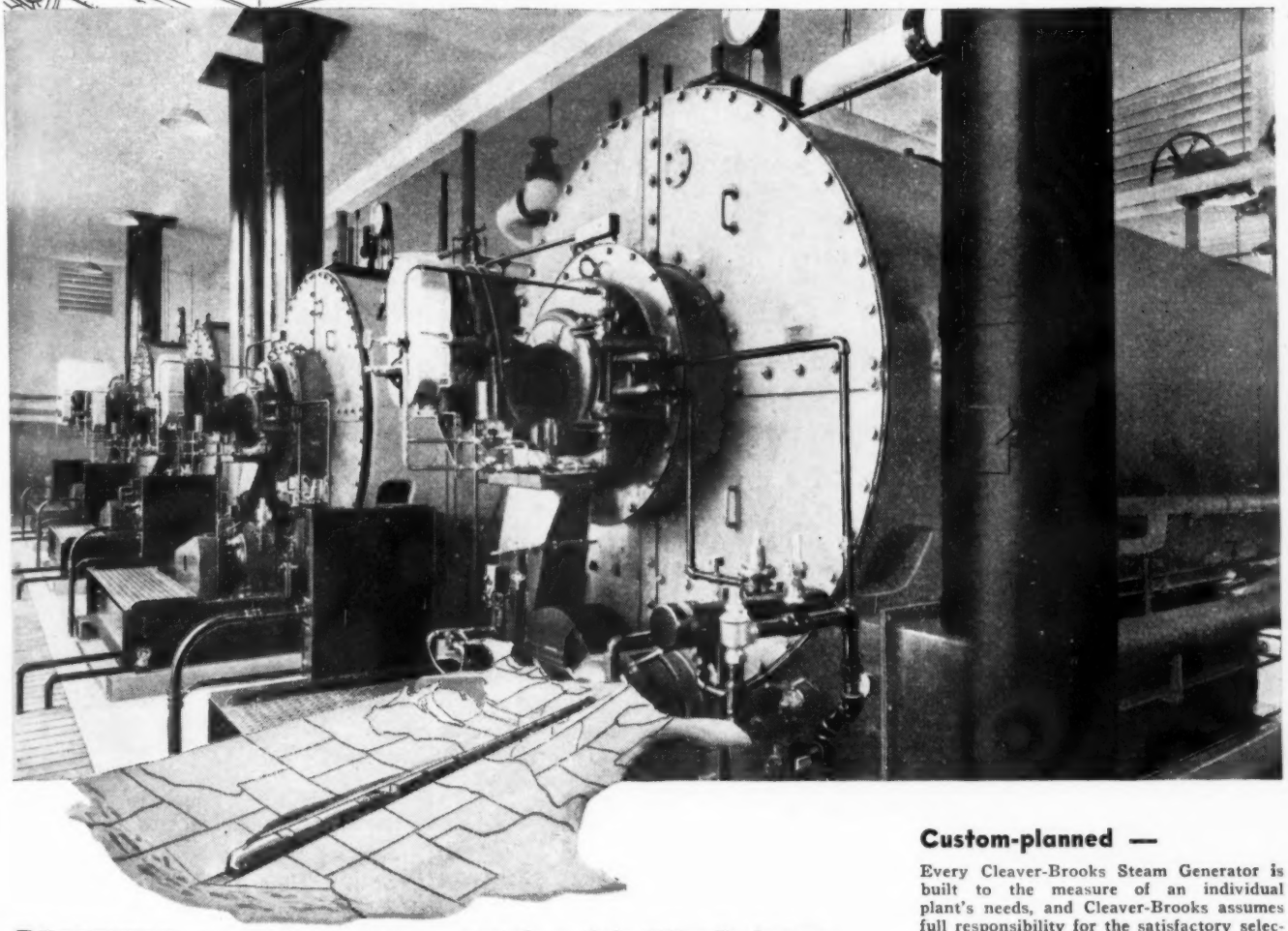
**Commercial Standard** CS131-46, entitled *Industrial Mineral Wool Products, All Types —Testing and Reporting*, is available on request to Div of Trade Standards, National Bureau of Standards, Washington 25, D. C. The standard covers purpose, scope, definitions, sampling and methods of testing and reporting.

**Thomas C Wilson, Inc,** executive personnel honored Mrs Martha A Wilson, president, and Mr Oreste J Bagnoli, vice-president and general manager, with a dinner party held at Drake Hotel, New York City, to commemorate the tenth anniversary of their election to these offices.



# MOVE A STEAM PLANT 'CROSS COUNTRY?

## *Read this Travelogue of Four Cleaver-Brooks Steam Generators*



URGENTLY in need of steam generating equipment, a prospective buyer on the West Coast heard of four steam "boilers" available in the East. Questions of purchase arose. Would it be much of a job dismantling them? Would it be worth while in terms of cost involved? If they could be shipped — how soon? How long would it take to re-install them?

Now these four available boilers were Cleaver-Brooks self-contained or "packaged" steam generators. Things began to happen. Within a few hours, the generators were loaded on flat cars and started on their 3000 mile journey.

Re-installation was equally simple. Since no settings or smokestack were required, the boilers were set into place, necessary service connections made, and in a short time these Cleaver-Brooks generators were in full operation.

The cost? . . . the original "boiler" and its component investment were fully recovered, except for minor installation costs. The above picture shows the final installation—note the clean, efficient appearance.

**CLEAVER-BROOKS COMPANY, 332 E. Keefe Avenue, Milwaukee 12, Wis.**

### Custom-planned —

Every Cleaver-Brooks Steam Generator is built to the measure of an individual plant's needs, and Cleaver-Brooks assumes full responsibility for the satisfactory selection and initial operation of the unit.

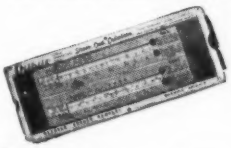
A qualified engineer analyzes load conditions, space and machinery arrangements. After installation, a factory engineer puts the steam generator into operation and trains plant employees on its operation, care and maintenance.

### Self-contained and "packaged"

Delivery consists of a "packaged" unit. Connections to service outlets are all that is needed. No smokestack is used — a simple vent carries away all products of combustion. No extra foundation is required. Compact — the unit fits into limited space and low headroom locations. Sizes: 22 models — 15 to 500 hp; pressures 15 to 200 lbs. p.s.i.

### Money-making performance—

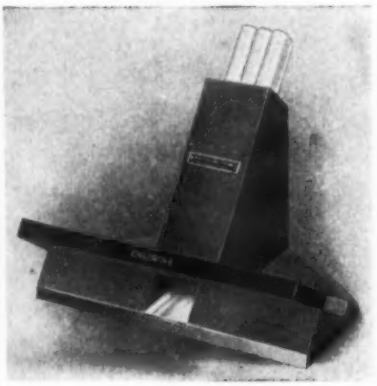
The Cleaver-Brooks Steam Generator is designed for easy operation and low upkeep cost. Operation is at 80% efficiency from full load down to 30% of its rating. The high heat transfer from the 4-pass, down-draft boiler produces fast steaming. A boiler room as clean as the home or office is possible through use of oil for fuel.



**WRITE ON YOUR BUSINESS LETTERHEAD** for the Free Steam Cost-Calculator — a ready-reference slide rule showing the comparative steam costs when using oil or coal as fuel.

**Cleaver-Brooks**
STEAM GENERATORS

*The*
**TAYLOR WATER ANALYZER**
*eliminates*
**Nessler Tube Standards**



**Complete range for each determination incorporated in ONE unit**

The Taylor Water Analyzer allows you to make a periodic check on silica in your boiler water and ammonia and pH of condensate without the need of handling fragile Nessler standards. Taylor Standards are enclosed in plastic . . . they're *accurate* . . . and they carry AN UNLIMITED GUARANTEE AGAINST FADING! Elimination of a single boiler shutdown will save many times the cost of a Taylor Water Analyzer.

For top performance, you should also employ a Taylor Phosphate Comparator. Using the same type of plastic-enclosed standard, you may get an accurate phosphate reading in two minutes. The method employed avoids interfering reactions with constituents other than phosphates . . . gives you true value.

| | |
|---|---|
| Taylor Water Analyzer (with any one slide) | $18.00 |
| Taylor Water Analyzer case | 17.50 |
| High or Low Phosphate Comparators, each | 19.00 |
| Extra Color Standard Slides, each | 8.00 |

See your dealer today, or drop a card in the mail for Taylor's authoritative 88-page book, "Modern pH and Chlorine Control" . . . it's free.

**W. A. TAYLOR AND CO.**
YORK & RODGERS FORGE RDS. • BALTO. 4, MD.


## APPOINTMENTS

**Allis-Chalmers Mfg Co** appointed R H Porterfield manager of new branch office at 1607 Industrial Trust Bldg, Providence, R. I. R E Scudder has been assigned to this branch as salesman. Joseph Bronaugh has been named manager of new branch office at 1404 Postal-Pacific Bldg, Miami, Fla.

William P Loyzelle becomes traffic manager for all div of **American Locomotive Co** except the railway steel spring div. His headquarters will be Schenectady, N. Y. Benjamin Davis continues as traffic manager of railway steel spring div, with headquarters in New York City. Don Campbell has been assigned to public relations staff of American Locomotive. He will also be editor of *Alco News.*

Thomas B Allardice joins **Combustion Engrg Co.** He will act as consultant in application of C-E steam-generating units to the utility industry.

**Gould Pumps, Inc,** announces election of C E Andrews as treasurer of company, succeeding E W Medden, who retired.

Glenn C Barnaby, Rialto Bldg, San Francisco, Calif., becomes district representative of **Terry Steam Turbine Co.**

**Brown Instrument Co** opened a sales and service office at 16 State St, Rochester, N. Y., under supervision of Gerald L Britton. O J Richardson has been appointed industrial manager at Detroit. George W Brown becomes industrial manager of Cincinnati office.

**Nordberg Mfg Co** announces appointment of John G Earle as special representative of its heavy machinery div. His headquarters will be at New York office, 60 E 42nd St.

W B Watterson becomes sales manager of **Air-Maze Corp.** Jules Gratiot has been made factory representative and field engineer for Air-Maze in Calif. and Ariz.

Appointment of Donald Dunwody as assistant branch manager of its New York sales district was announced by **Monsanto Chemical Co's** phosphate div., New York district embraces Penn., N. Y., N. J., Md. and western Mass. and Conn.

**Wheelco Instruments Co** announce addition of Francis H Beaupre and Bruno H Ramthun to application engineering dept.

Andrew S Ormsby has been elected director of industrial relations of **Worthington Pump & Machinery Corp.** P A Alers manager of El Paso, Tex., office.

Charles E Wilson, vice-president of **Worthington Pump & Machinery Corp,** Harrison, N. J., has been elected president of Worthington-Gamon Meter Co, Newark, N. J., a subsidiary. C A Packard was appointed vice-president and comptroller.

P J Patton Jr was recently appointed regional manager by industrial div, **Ransome Machinery Co,** Dunellen, N. J., a subsidiary of Worthington Pump & Machinery Corp.


**STOP FISH**

**BY ELECTRONICS**

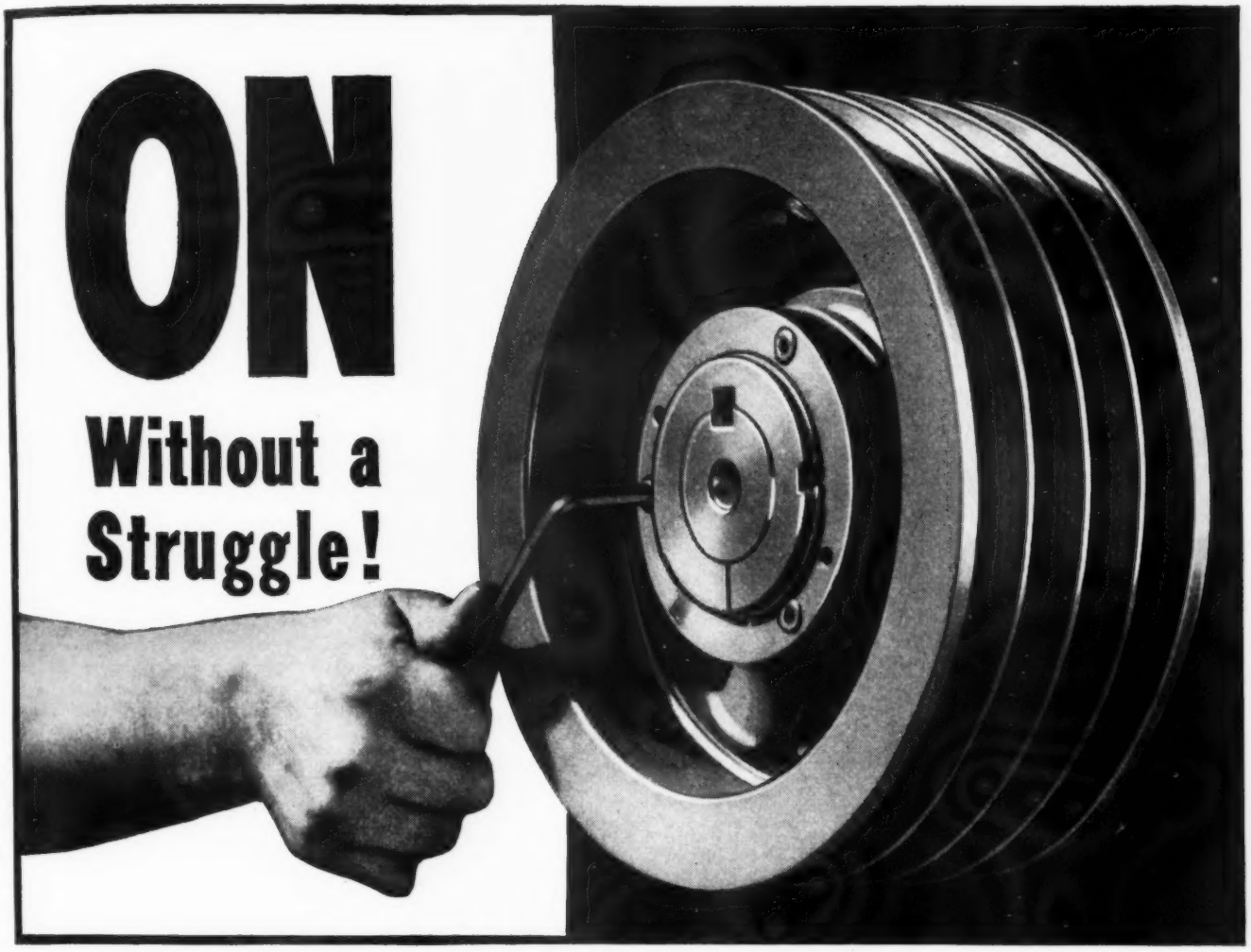
This patented fish control method employs modern electronics in overcoming a serious operating and maintenance problem. Fish of all sizes are kept at a *safe distance* from intake structures, or screens, by the use of an Electronic Control Unit. This equipment, generating special electrical impulses, energizes an electrode system designed and engineered for your particular fish control problem.

The Burkey Electric Fish Screen has been thoroughly proven through years of service in Condensing Water Intakes, Hydroelectric Plants, Water Systems and Industrial Pumping Installations. DOES NOT STUN OR KILL FISH.

*Recommended by State Conservation Officials.*

*Free literature and quotations upon request.*

**Electric Fish Screen Co.**
1130 No. Poinsettia Place
Hollywood 46, California




# "MAGIC-GRIP" FITS...even on Oversize or Undersize Shafts

"Magic-Grip" sheave needs no reaming, no filing, no sledge hammer on oversize shafts . . . grips undersize shafts without weave or wobble. And . . . you need no wheel puller to get it off.

The secret is in patented hub construction. "Magic-Grip" sheave comes fully assembled, with tapered split bushing of generous clearance for oversize shafts. Yet . . . when you tighten three cap screws, it locks on the shaft with the grip of a vise.

There's no struggle. Anyone can mount this sheave quickly, easily, accurately. It saves time, labor and money . . . can't damage shaft . . . prolongs bearing life because it mounts close, reduces overhang and vibration. And these advantages cost you nothing extra!

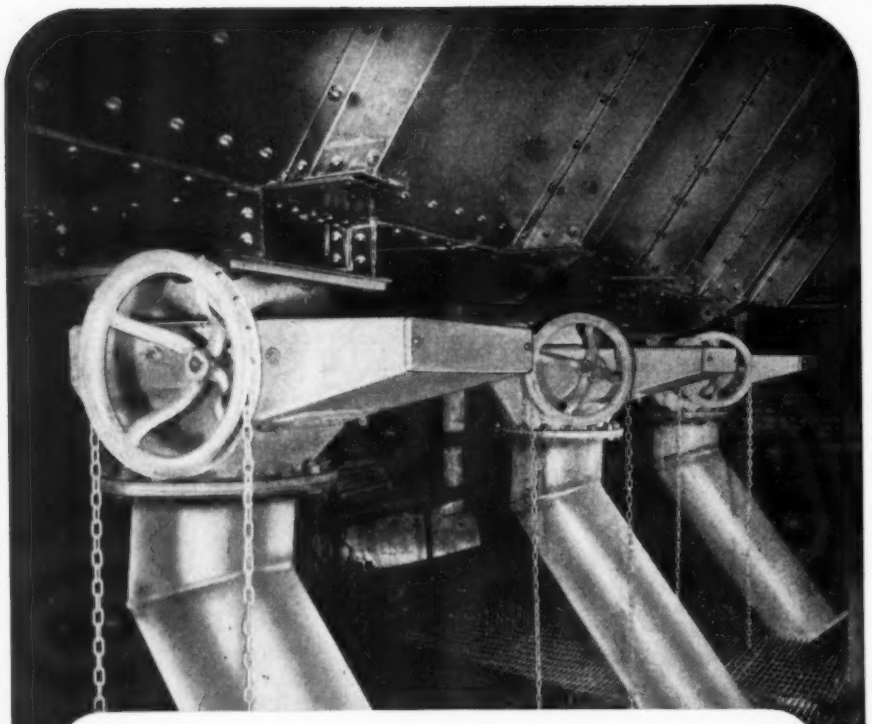
**YOUR V-BELT DRIVE HEADQUARTERS**

Call your nearest Allis-Chalmers office or dealer for TEXROPE "Magic-Grip" sheaves, Texsteel, Texdrive and Vari-Pitch sheaves, Speed Changers and famous TEXROPE Super-7 V-Belts. Full range of types and sizes. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 2036

## ALLIS CHALMERS TEXROPE V-BELT DRIVES

**HEAR THE BOSTON "POPS"**: *Every Saturday Evening, American Broadcasting Co.*



# COAL VALVES

## should be "prescription-built"

● Coal Valve requirements vary from plant to plant—no two have the same coal feeding problms. That's why we base the design of S.E. Co. Coal Values on a careful *and continuing* study of current boiler plant requirements. Because of this, the standard S.E.Co. Coal Valve will fit most every need. If it doesn't meet your specific needs we are prepared to specially engineer a S.E.Co. Coal Valve that will!

**S.E.Co. Coal Valves *are!***

To illustrate the variety of S.E.Co. Coal Valves—there are 122 standard sizes available! We make them in 7 basic sizes, with square or round top and bottom flanges, with studs in the top flange or bolted top flange. These arrangements are available in any combination, for vertical or inclined installations. We build a large number of modifications so that whatever your needs, there *is* a S.E.Co. Coal Valve to suit your requirements.

**Write** for catalog sheets. Address Stock Engineering Co., 715 Hanna Bldg., Cleveland 15, Ohio.

STOCK ENGINEERING CO.

★ CONICAL Non-Segregating Coal Distributors ★ S.E.CO. Coal Valves and Coal Scales

with offices at 400 W Madison St, Chicago. He is in charge of sales in Middle Western area, including such industrial centers as Chicago, Detroit, Cleveland and St. Louis.

**Westinghouse Electric Corp** elects David W R Morgan general manager of entire S Philadelphia works. His responsibilities include general supervision of aviation gas-turbine div and Attica, N. Y., plant of stoker dept. Mr Morgan retains direct management of steam div. Franklin L Snyder has been made engineering manager of Sharon transformer div and A C Farmer has been appointed assistant to John K Hodnette, who is manager of this div. Specialty transformer dept of Sharon transformer div has been organized with Chris H Bartlett as manager, A E Black as general foreman, and Frank E Baker section engrg manager.

L E Lynde has been appointed manager of New England district of **Westinghouse,** with headquarters at Boston. F L Nason will become a special representative of the company in the New England district. Sidney C Palmer becomes transportation and marine div manager and F S Bacon central station manager for New England district. W D Ligon has been appointed works manager of new Buffalo plant into which motor div is moving from E Pittsburgh.

Manufacturing and engineering facilities of **B F Sturtevant Co,** purchased by Westinghouse in 1945, are being integrated with facilities of Westinghouse air-conditioning div, which has been transferred from Jersey City to Sturtevant main plant at Hyde Park, Boston. Ellis L Spray becomes executive vice-president of the new organization, which is known as B F Sturtevant Co, div of Westinghouse Electric. G C Derry has been elected vice-president and general manager and is responsible for over-all operation of the business of this subsidiary. E B Williams continues as vice-president of Sturtevant, with responsibility for continued development of power and marine activities of the new subsidiary.

**Condenser Service & Engrg Co,** 95 River St, Hoboken, N. J., acquired Edge Moor Iron Works, Inc, Edge Moor, Del.

**McClave Co,** Allentown, Pa., announced election of K R Manville as president, J R Gainfort as vice-president and general manager, and G J Reinsmith as treasurer. K R Manville succeeds R B McClave as president.

Mechanical goods div of **United States Rubber Co** appointed Frank M Urban merchandise manager, and Walter F Spoerl general sales manager.

Appointment of Paul W Zumbrook as manager of domestic lubricating oil sales of **Sinclair Refining Co** was announced.

Roland C Disney has been appointed manager of eastern district of **Baldwin Locomotive Works.**

**American Engineering Co,** Philadelphia, announces following appointments: F C Messaros, chief engineer; J S Frame, chief draftsman. Frederick S Schwarz is in charge

# An Entirely Different BRAIDED PACKING

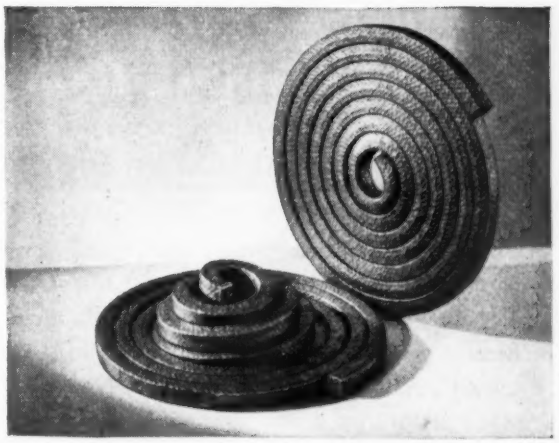
The strands of GARLOCK *Lattice-Braid* packing are braided *through and through* in an entirely new and different way from ordinary braided packings. All strands are lattice-linked together into one structural unit.

Result: (1) *unusual flexibility* and semi-automatic pressure action which enables the packing to function more efficiently; (2) *longer life*, because the strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

GARLOCK *Lattice-Braid* is furnished in several styles for various types of service.

THE GARLOCK PACKING COMPANY,
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

Patented Construction



Garlock 731 Lattice-Braid Coil

# GARLOCK *Lattice-Braid* PACKING

U.S. INSTRUMENTS Tell The Truth

USG

PRESSURE, TEMPERATURE, FLOW, ELECTRICAL AND LEVEL MEASURING INSTRUMENTS

UNITED STATES GAUGE

6 out of 10 manufacturers of original equipment specify U.S.G.

DIVISION OF AMERICAN MACHINE AND METALS, INC.

SELLERSVILLE, PENNSYLVANIA (15)

Specify MACWHYTE ELEVATOR ROPES to your Elevator Maintenance Man

6 x 19 Macwhyte Traction Steel, PREformed or Non-PREformed

For safety, service, economy, you can't beat Macwhyte Elevator Ropes. They contain extra tough, flexible wire drawn under strict metallurgical control from selected steels in our own mill.

Ask your Elevator Maintenance Man for these ropes which have a minimum of stretch, yet ample flexibility to withstand bending fatigue. He can get them from Macwhyte Distributors and Mill Depots.

MACWHYTE COMPANY

2944 Fourteenth Avenue, Kenosha, Wisconsin

Makers of the correct ropes for your equipment

MACWHYTE COMPANY 50th Year 1896 – 1946

8 x 19 Macwhyte Special Traction Steel, PREformed or Non-PREformed

NO. 869-E

PREformed and Non-PREformed elevator ropes for low-cost-per-car-mile service

of new sales office at 327 S LaSalle St, Chicago. Roy A Stipp, Blue Bldg, Greenville, S. C., has been made sales representative in Carolinas and eastern Tennessee.

**Leslie Co** announces several changes in officers: S Inglis Leslie has been elected chairman of board of directors. John S Leslie was elected president.

J Elmer Housley, district power manager, Aluminum Co of America, Alcoa, Tenn., has been nominated for presidency of **American Institute of Electrical Engineers.**

Leonard M Freeman has been appointed manager of newly established works laboratories of **B F Goodrich Co,** which will handle technical service, development and training of technical personnel. In the group are the general chemical laboratory, raw materials inspection and development dept and physical testing laboratories. Thomas J Cain Jr has been elected director of safety for all Akron plants. He will head an expanded safety program of industrial relations dept of which D D Reichow is manager. Walter L Schneider, safety engineer, will handle technical phases.

Following recent death of its founder and president for 33 years, Carlton N Aborn, board of directors of **Laminated Shim Co** elected following officers: James A Aborn, chairman of board; E B Nisbet, president; A V Anderson, executive vice-president and treasurer. At the same time, H B Swindells was made purchasing agent.

**Homestead Valve Mfg Co,** Coraopolis, Pa., has appointed William E Thomas div sales manager of valve sales in Southeastern territory, with headquarters in Atlanta.

Directors of **Foster Wheeler Corp** have elected H S Brown as chairman of board to succeed his brother, the late J J Brown. Mr Brown will continue as president of the corp, in addition to his new post. David McCulloch, executive vice-president, was named chairman of executive committee.

**International Nickel Co** announces opening of Empire State technical section of its development and research div. Gilbert L Cox, metallurgical and chemical engineer, will be in charge.

Albert J Hulse joined **Youngstown Sheet & Tube Co** as chief engineer.

**James G Biddle Co** announces consolidation of its offices and factory at a new location, 1316 Arch St, Philadelphia.

**Thermoid Co** announces election of Dwight P Allen as executive vice-president. H C Anderson becomes director of research.

Newly appointed assistant directors of research of **Caterpillar Tractor Co** are following: L A Blanc, who will be in charge of physical, chemical, combustion and metallurgical projects; W L H Doyle, supervisor of special investigations and general research projects, including liaison with cooperative and national research activities; C R Maxwell, in charge of diesel engine, combustion systems and fuel-injection de-

# WHEN SPACE IS A FACTOR IN DUST COLLECTION

To the many plants faced with meeting severe conditions of local dust ordinances and yet lacking suitable space for a conventional dust collector installation, the following examples of Thermix Tubular installations will provide food for thought:

● In a 125,000 lbs. per hour unit, a Thermix Tubular was installed at the bottom of the tubular air preheater . . . *in the same floor area* . . . using the preheater hoppers for the dust collector.

● A Thermix Tubular Dust Collector was installed *in the bell* of an 8′ diameter stack, handling a 300,000 lb. per hour pulverized fuel boiler.

● In a large paper mill using five pulverized fuel boilers, designs of which did not include provisions for a dust collector, Thermix Tubular Collectors were successfully installed.

These and many others are testimony to the minimum space requirements of Thermix Tubular Dust Collectors, available in extremely compact, easily installed six and nine inch diameter tubes . . . their high efficiency is an established fact.

Write for our suggestions for solving your dust collection problems.

●

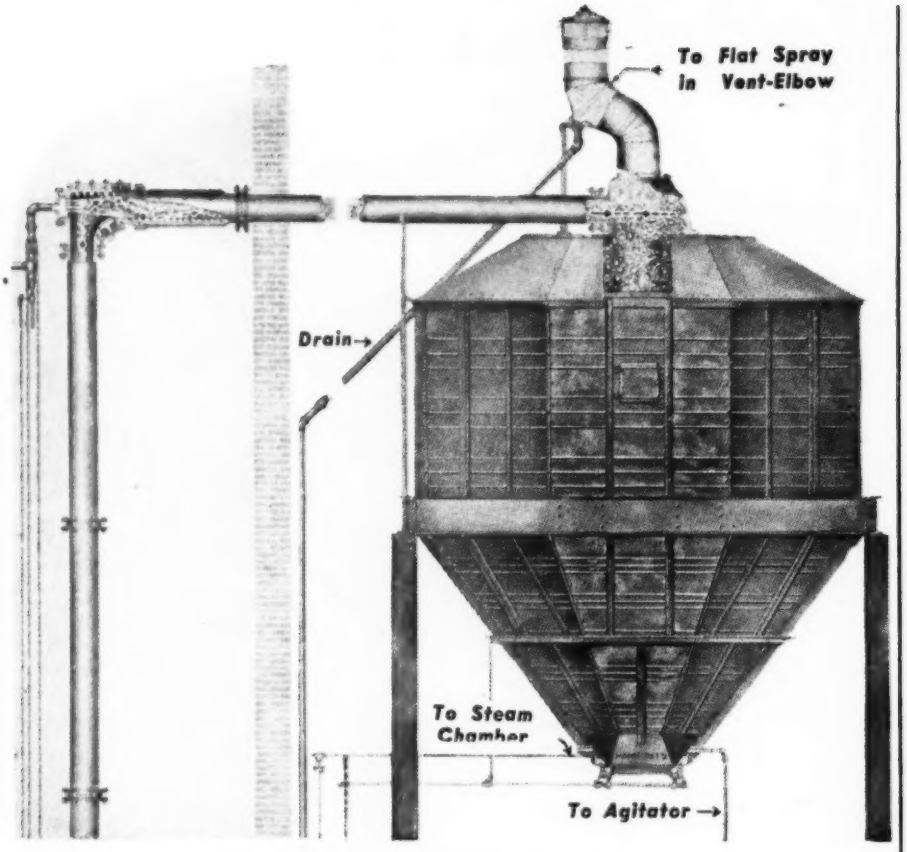
**THERMIX ENGINEERING COMPANY**

***Project and Sales Engineers***

**First National Bank Bldg.** **Greenwich, Conn.**

# PRAT-DANIEL CORPORATION

**EAST PORT CHESTER, CONN.**




## SEMI-VACUUM ASH CONVEYOR . . . *with*

**. . . efficiently operating steam-jets**
**. . . amply long elbow-set with corundum-insert liners**
**. . . simple and effective dust-eliminating vent**

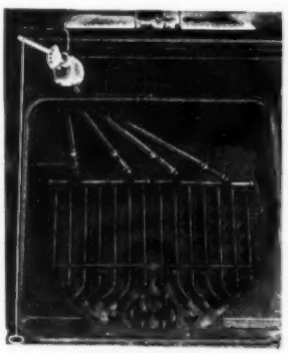
Existing conveyors can be considerably improved in steam-consumption and maintenance through our superior fittings and frequently through rearrangement of present layouts.

## DURABLE and ALWAYS DISCHARGE-EFFICIENT OCTAGONAL CAST IRON SECTIONAL ASH TANK

Also cast iron sectional bunkers of discharge-efficient and self-clearing designs, preventing spontaneous combustion of the coal and its hazardous trimming in the bunker.

## MECHANICAL SOOT BLOWERS for FIRE-TUBE BOILERS

- "Efficiency 100% — requiring no hand-cleaning."
- Every tube swept clean of soot and fly-ash END TO END—no matter how irregular the tube-layout may be.
- Minimum steam or air-consumption—as operation (four successive puffs of steam or air) requires only about one minute.
- No cutting of tube-sheet or tube-beads possible—as a nozzle is centered to each tube permanently.
- No maintenance — as there are no moving parts in the hot boiler.



Installation with H.R.T. Boiler

**HAHN EQUIPMENT CORPORATION**
(Formerly Hahn Engineering Co.)
30 CHURCH STREET, NEW YORK 7, N. Y.


velopment projects; and C R Shad, in charge of organization, personnel and operational activities. J M Davies, present assistant to C G A Rosen, director of research dept, will assume added responsibilities, including tractor, earth moving, special products and current product revision projects as well as all field activities.

F A Sarcone, **Hall Laboratories** engineeer in water chemistry, has been transferred to St. Louis staff, to be identified with service work in St. Louis and Kansas City areas. He will service clients in states of Neb., Kan. and Okla., as well as doing a limited amount of work in St. Louis area.

**Helicoid gage div, American Chain & Cable Co,** appoints Midwest Controls Co as its Helicoid gage representative in Des Moines, Iowa, and C Emery Nelson as its representative in Minneapolis, Minn.

Austin W Fisher and Bruce S Old have joined the staff of **Arthur D Little, Inc.**

**Lockwood Greene Engineers, Inc,** elected Chester S Allen president.

James T Coatsworth assumes position of commercial director of **Edison Electric Institute.**

William McClellan retired as director and chairman of board of **Union Electric Co of Mo.** James H Grover also retired from Union Electric's board. Management candidates for places on board to succeed Messrs McClellan and Grover are David R Calhoun and Benjamin M Loeb.

Promotion of Bruce J Jensen to general lighting representative of **Public Service Electric & Gas Co,** is announced. Mr Jensen succeeds William T Blackwell who retires. Eugene M Fahey has been named assistant general lighting representative.

Edgar Hawkins assumed new duties as head of electric, gas and water departments of **Danville, Va.**

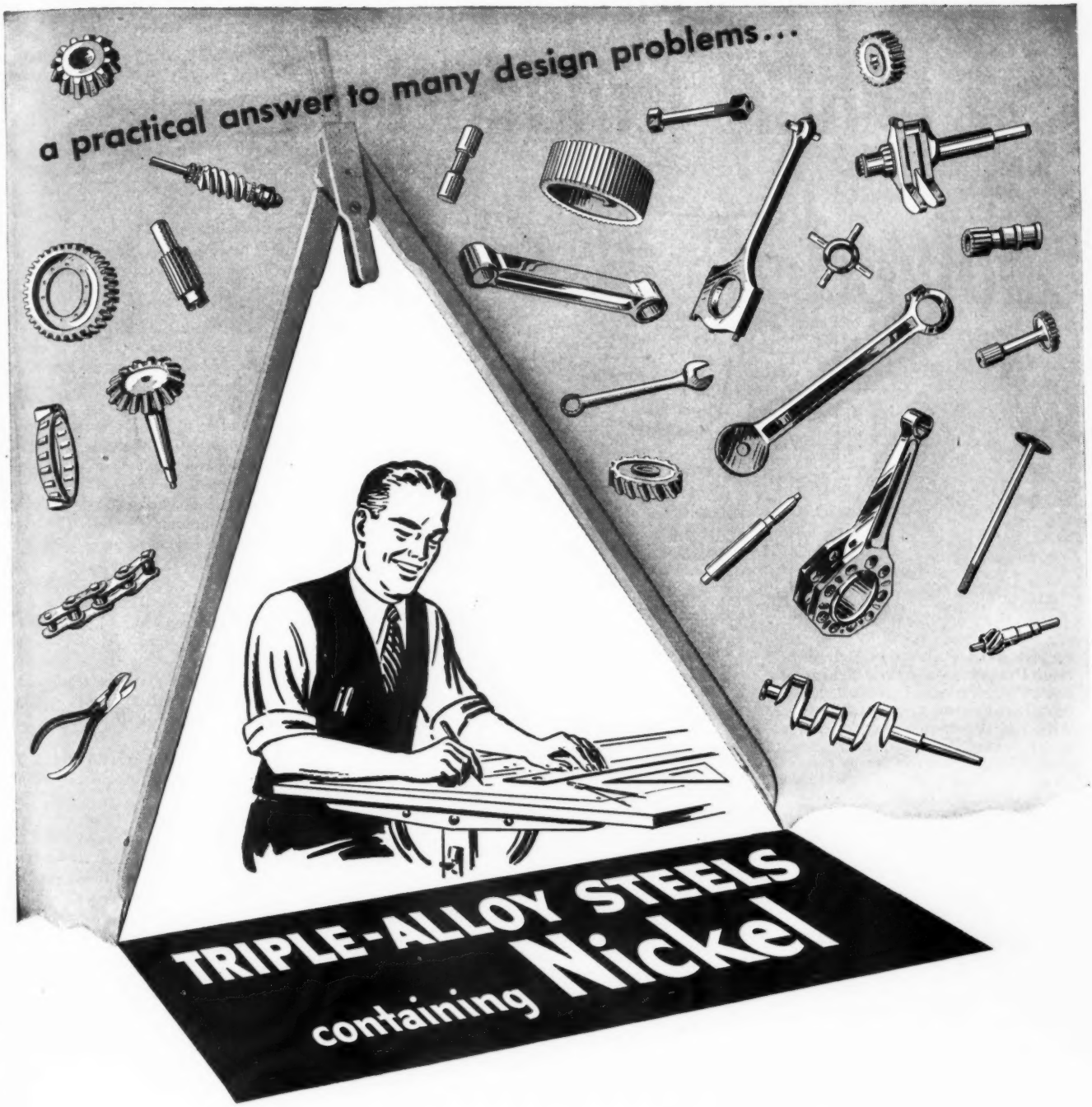
New directors of **Cleveland Electric Illuminating Co** are Robert F Black, Severance A Millikin and Dean C Ober.

**Appalachian Electric Power Co** announces appointment of John P Cruickshank as superintendent of transmission and distribution at Roanoke, Va.

R W Diamond has succeeded the late S G Blaylock as director of **West Kootenay Power & Light Co, Ltd,** in Canada.

**Canadian Niagara Power Co** elected following officers: John E Lawson, president; Norman R Gibson, chairman of board of directors; W Donald Bracken and Arthur W Jackson, vice-presidents; Mary Louise Bottomley, secretary; Leonard G Goldsborough, treasurer and assistant secretary; Helen McCall, assistant treasurer.

**Lincoln Electric Co** added following representatives to their district field office staffs: John F McFeeters joined welding engineers in Kansas City, Mo., office. Hubert G Hinkle




Triple-alloy steels containing Nickel offer designers the following *triple* advantages:

1. OUTSTANDING PERFORMANCE—Strength and toughness, resistance to wear, fatigue or shock to meet a wide range of requirements, as dictated by design.
2. RELIABILITY—based on consistently uniform response to heat treatment.
3. ECONOMY—resulting from standard compositions precisely graded to match the engineers' needs.

Service records established by triple-alloy steels over a period of years show that they are giving excellent results in many diverse and exacting applications.

The large number of standard compositions available, including the 4300, 8600, 8700, 9300 and 9800 series, permit accurate and economic selection for specific uses.

Because of their many advantages, these triple-alloy steels warrant your careful consideration when planning new or improved designs. We shall be glad to furnish counsel and data upon request.

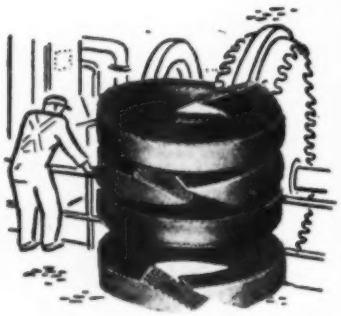
**THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N. Y.

# 3 Sealing Problems Solved—

*These three packings are representative of the extra values built into each product in the complete Belmont line. For every service . . . steam, water, oil, gas, air, acids, alkalis, ammonia . . . your Belmont Distributor has the right packing.*

**For high pressure steam rods** Belmont 30 High Pressure Asbestos Packing has center block pleated on itself, accordion-fashion, at approx. 90° angle with rod. High resiliency and flexibility, extra take-up, extra "edge wear" if packing wears to block.

**For "boiling in oil"** Belmont 189 Hot Oil Asbestos Packing has extra resistance to penetration. Long-fibre asbestos yarn is firmly braided, each strand treated with a special compound so that saturation and penetration are minimized.



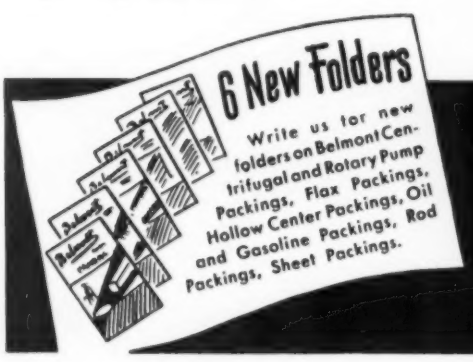
**Hollow Center Packing,** Belmont 19 provides a point of least resistance for expansion and contraction. Packing "breathes" toward the hole, so friction is kept at minimum point created by the working pressure itself. Light-weight—economical.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

IN THE BLUE-AND-ORANGE BOX

**There is a Belmont Packing for Every Service**

Belmont distributors are located in every large industrial center, ready to give you prompt delivery from local stocks.


6 New Folders
Write us for new folders on Belmont Centrifugal and Rotary Pump Packings, Flax Packings, Hollow Center Packings, Oil and Gasoline Packings, Rod Packings, Sheet Packings.

**THE BELMONT PACKING AND RUBBER CO.**

Butler and Sepviva Streets
Philadelphia 37, Pa.


has been assigned welding engineer in Columbus, O., area. K S Lamb has been named welding engineer in New York territory. Thomas W Day has been appointed welding engineer at St. Louis office.

Expansion of **Sinclair Refining Co's** national accounts div under direction of William Fletcher Farrell was announced.

**Frank L Wadsworth,** professional engineer, resumes his prewar business connection as engineer, associated with Siegmund Firestone, architect and consulting engineer of Rochester, N. Y.

**John R McDermet,** consulting engineer, announces opening of an office from which he will supply advisory service on industrial use of water, corrosion control, etc.

Benjamin P McDaniel has been named vice-president in charge of client relations of **Associated Engineers, Inc,** Fort Wayne.

**Reliance Electric & Engrg Co** is building a new plant in Ashtabula, O. Karl H Meyer will become factory manager of plant.

**Wm W Nugent & Co** appointed following representatives: Crofton Diesel Engine Co, Foot of G St, Fishermen's Wharf, San Diego, Calif.; Casey Boat Bldg Co, Fairhaven, Mass.; Dempsey Equipment Co, 1 Star Sq, Long Island City, N. Y.; George A Krutilek, P O Box 227, El Paso, Tex.; Olympic Supply Co, 1743 First Ave, Seattle, Wash.

Richard C Ulmer is now affiliated with **E F Drew & Co** as technical director of boiler-water treatment div.

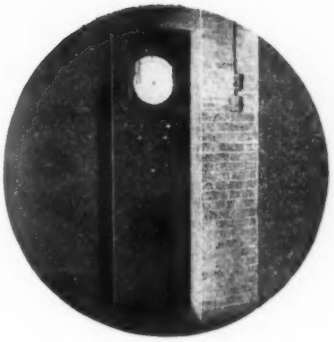
**Sterling Engine Co** announces opening of a direct factory branch at Russ Bldg, San Francisco, Calif., to serve territory west of Rocky Mountains. Hans Bohuslav, vice-president, will be executive in charge and will also continue to direct engineering development and research.

**Hammel-Dahl Co,** Providence R. I., announces appointment of Russell Milham as district sales engineer, in charge of their Chicago and Midwest district. He is at 53 W Jackson Blvd, Chicago 4, Ill.

Walter F Green has been promoted to assistant manager of **Timken Roller Bearing Co's** div of research and development, while Joseph M Roshong has been named superintendent of this div. Harley J Urbach has been appointed works engineer. F R MacFadyen has been transferred to Canton engrg dept of Timken Roller Bearing Co as industrial engineer. He will act as assistant to S M Weckstein and Paul Haager.

**Buffalo Forge Co** and Buffalo Pumps, Inc, moved to 345 Fourth Ave, Pittsburgh 22, Pa. H Lee Moore is their representative.

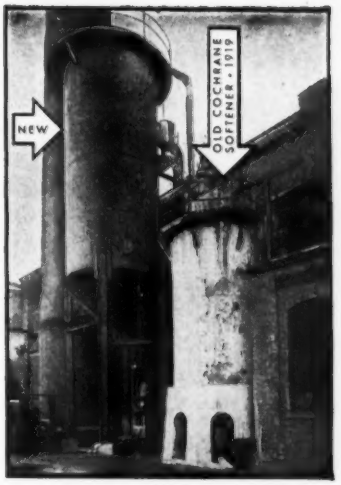
Establishment of a new district sales office in Indianapolis and changes involving its district sales offices in Los Angeles, San Francisco and South Bend, Ind., have been announced by **Jones & Laughlin Steel Corp.** H M Knobloch has been appointed district sales manager in Indianapolis. R G



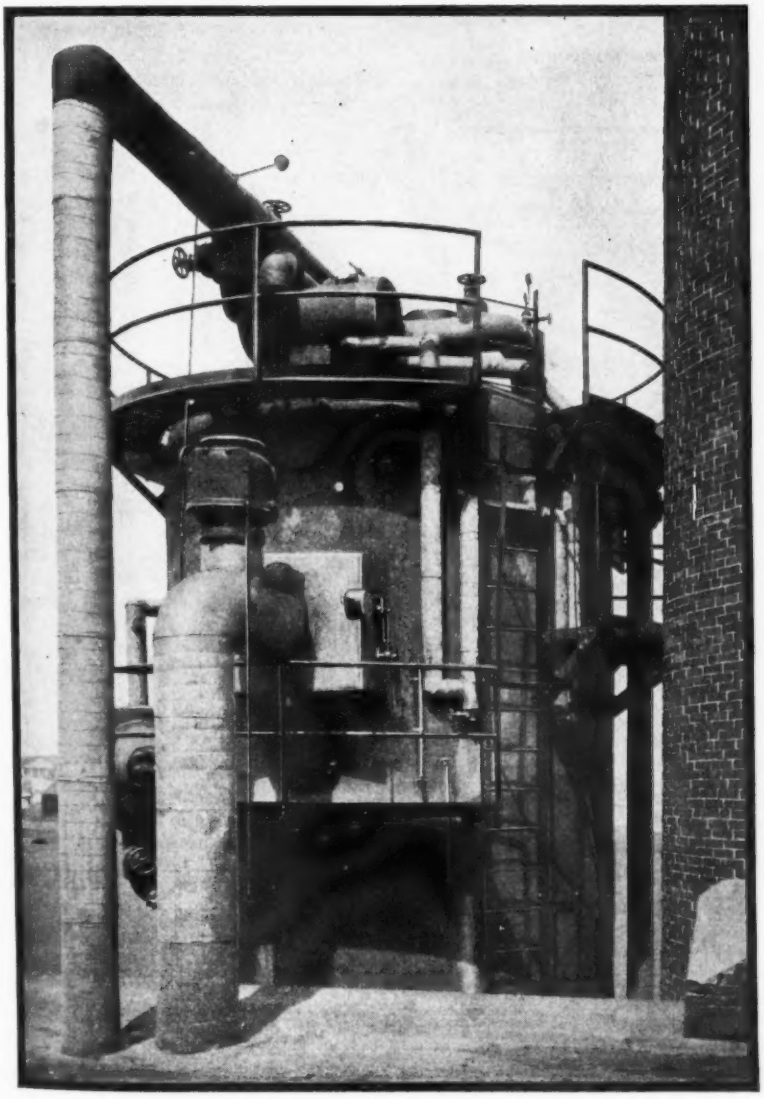
*Above: Cochrane Flow Meter Panel for Automatic Control of Chemical Feed.*

# HISTORY REPEATS

(and Cochrane Water Conditioning Equipment)




COCHRANE Water Conditioning Equipment does its work so thoroughly, so efficiently and with so little extra upkeep costs that "repeat" orders are the rule rather than the exception. The Deaerating Hot Process Softener shown in these photographs was ordered to replace the old Cochrane Hot Process Softener shown alongside it. This older piece of equipment is still functioning, but was not able to handle the increased load. At last reports it was destined to be shifted to another job. Write for details of this installation and facts about Cochrane Hot Process Water Softeners. Cochrane Corporation 3106 N. 17th St., Philadelphia 32, Pa.

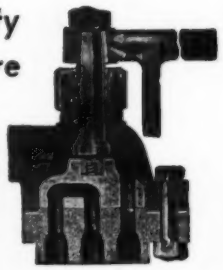


*Left. Upper part of Softener showing Deaerator Mechanism and Cochrane Multiport Relief Valve.*

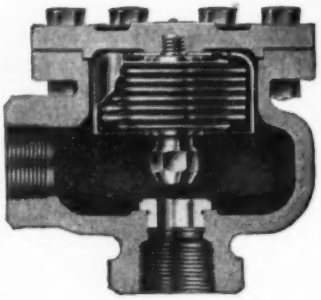
COCHRANE

# NICHOLSON TRAPS AND VALVES CAN "TAKE IT"

*Feature Durability and Simplicity that Maintenance Engineers Admire*



*NICHOLSON THERMOSTATIC TRAPS —2 to 6 times greater valve area gives enormous discharge capacity. 5 types: sizes 1/4" to 2"; pressures to 225 lbs. Bulletin 544.*

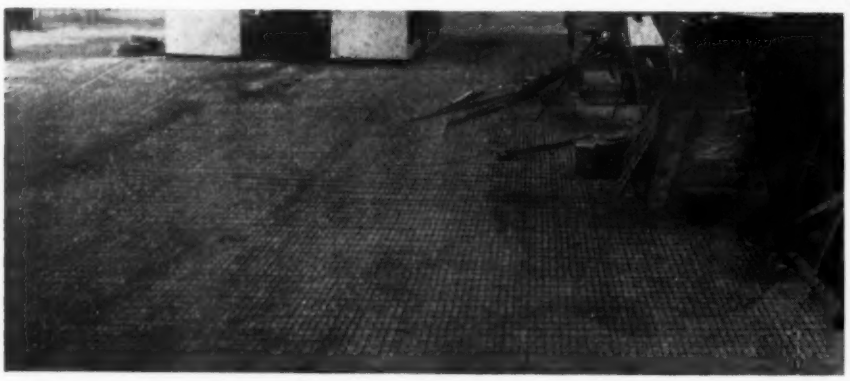


*CYLINDER CONTROL VALVES — Types for many mediums; pressures to 5000 lbs. Catalog 543.*

If you're suffering from traps and cylinder control valves that can't stand necessary abuse it's time to inquire about Nicholson units. In plain words, they have the kind of "guts" maintenance engineers admire. Precision-made throughout. For details of exclusive Nicholson features send for catalogs or see Sweet's.

**W. H. NICHOLSON & CO.** 125 OREGON ST. WILKES-BARRE, PA.





# This Armored Floor Never Wears Out!

Hendrick's Mitco Armorgrids add great strength and rigidity to floors, platforms, ramps and driveways subject to shock, grinding loads and continuous wear. Floors of cement, asphalt, mastic or other compositions never require replacement when reinforced with Mitco.

Mitco Armorgrids are completely fabricated units, requiring no bolts, rivets or assembly work—and unlike other floor armorings do not depend on fill for development of full strength. Write for Mitco Booklet today.

**HENDRICK**

*Manufacturing Company*

**46 DUNDAFF STREET, CARBONDALE, PENNA.**

*Sales Offices In Principal Cities*

**Perforated Metals**
**Perforated Metal Screens**
**Architectural Grilles**
**Mitco Open Steel Flooring, "Shur-Site" Treads and Amorgrids.**


Scoggins has been made district sales manager in Los Angeles. He succeeds T W Bell who became special sales representative in Los Angeles. W S Wainwright has been named district sales manager in San Francisco. W L O'Connell has been appointed resident manager of sales in South Bend.

**Northern Equipment Co** appoints Kissick Co, 1524 Chestnut St, Philadelphia, Pa., as sales and service representatives for Copes feedwater regulators, pump governors, desuperheaters and allied equipment. Territory includes southern New Jersey, southeastern Pennsylvania, eastern Maryland, Delaware.

**Raybestos-Manhattan, Inc,** announces that Harry E Smith of the Manhattan div, Passaic, N. J., corporation vice-president, will be in complete charge of corporation rubber product sales and marketing.

Robert S Green becomes president of **A P Green Fire Brick Co,** succeeding his father, Allen P Green, founder of the company, who moves up to post of chairman of board. An executive committee of the board of directors, composed of H B Plunkett, Lester J Miller, A D Bond, Walter G Staley and Allen P Green Jr, was created. Working with the new president will be a management committee in charge of operations. Members of this committee will be J Harrison Brown, D H Kreutzer and Neal S Wood, with Robert S Green as chairman.

A E Aldridge has been made general advertising manager of **Sun Oil Co.**

**Cutler-Hammer, Inc,** announce following appointments on their research and development staff: C T Evans as consulting engineer, C W Kuhn as assistant manager of development, R A Millermaster as assistant manager of development.

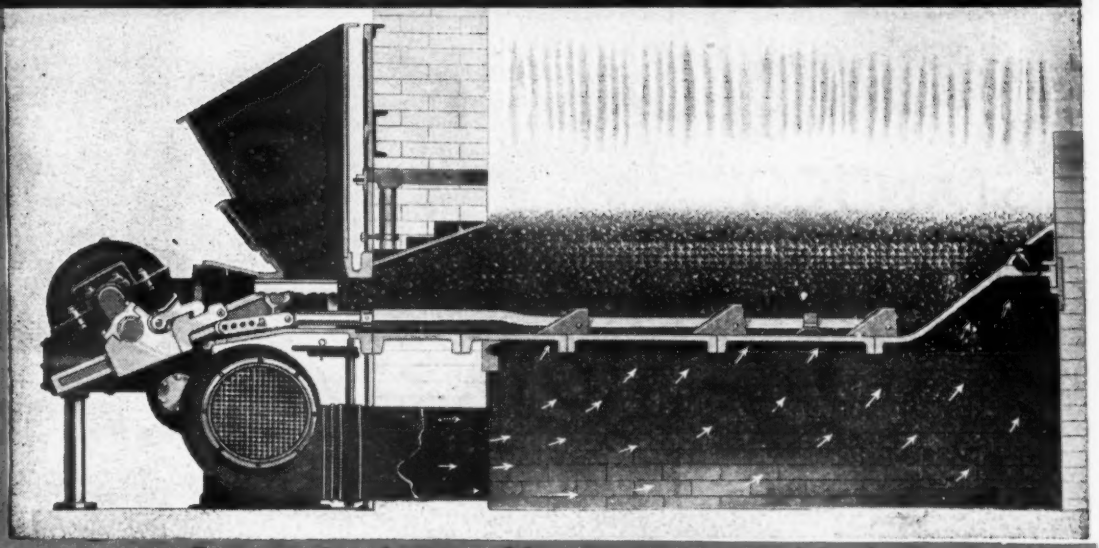
E P Wood has been made vice-president of **Stevens & Wood, Inc.**

H F Spoehrer, vice-president of Sporlan Valve Co of St. Louis, was elected president of **Refrigeration Equipment Manufacturers Assn.** Other new officers are Edward M Flannery of Bush Mfg Co, Hartford, Conn., vice-president; Guy J Henry of Henry Valve Co, Chicago, treasurer; and C H Benson of Imperial Brass Mfg Co, Chicago, treasurer. Newly elected to board of directors are K B Thorndike, manager of Chicago office of Detroit Lubricator Co; G E Graff of Ranco, Inc, Columbus, O.; R H Israel of Virginia Smelting Co, W Norfolk, Va.; H F Hildreth of Westinghouse Electric Corp, Springfield, Mass.; and J W Krall of Tyler Fixture Corp, Niles, Mich.

**American Society of Heating and Ventilating Engineers** appoints Clyde A McKeeman assistant to president.

Appointment of a synthetic liquid fuels technical advisory group, composed of eleven outstanding chemists and engineers from industry, was announced by **Bureau of Mines.** Members of the group are Eugene Ayres, staff chemist on process development for Gulf Research and Development Co, Pittsburgh, Pa.; George Creelman, research engineer for Pittsburgh Consolidation Coal

# IT'S THE DESIGN



Deep sectional retort of large capacity. Coal feed and distribution by dependable plunger feed.

# DETROIT UNISTOKER

Provides flexibility to handle fluctuating loads.

HEAVY MECHANICAL DRIVE REQUIRES LITTLE POWER
SAFETY SHEARING PIN
HAND COAL ADJUSTMENT
AUTOMATIC ADJUSTMENTS OF COAL AND AIR SUPPLY
DETROIT ADJUSTABLE FEED
(COAL FEED CONTROL)

## DETROIT STOKER COMPANY

**Gives You**
LONG, TROUBLE FREE SERVICE!

Fig. 1635

**"STANDCO"**
**PILLOW BLOCKS**

The attractive "Standco" Pillow Block shown above is sturdily built and is offered in a wide range of sizes. Babbitted and broached bearing surfaces, accurately machined faces. Can be amply lubricated.

***Write for Bulletin***

"Unbrako" and "Hallowell" products are sold entirely through distributors.

*Over 43 Years in Business*

**STANDARD PRESSED STEEL CO.**
JENKINTOWN, PENNA., BOX 577
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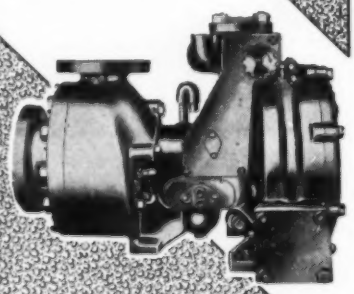
St. Louis • San Francisco



**COFFIN TURBO PUMPS**

FOR BOILER FEED AND GENERAL HIGH PRESSURE SERVICE



**THE J. S. COFFIN, JR., CO.**
ENGLEWOOD, NEW JERSEY


Co, Pittsburgh, Pa.; Fred Denig, vice-president and director of research for Koppers Co, Pittsburgh, Pa.; H W Field, assistant manager of research and development dept for Atlantic Refining Co, Philadelphia, Pa.; H O Forrest, director of research for M W Kellogg Co, New York, N. Y.; Louis S Kassel, research engineer for Universal Oil Products Co, Chicago, Ill.; P C Keith, president of Hydrocarbons Research, Inc, New York, N. Y.; L C Kemp Jr, director of research for Texas Co, New York, N. Y.; E V Murphree, vice-president in charge of research and development for Standard Oil Development Co, New York, N. Y.; J K Roberts, director of research for Standard Oil Co of Ind., Chicago, Ill.; and Harold J Rose, vice-president and director of research for Bituminous Coal Research, Inc, Pittsburgh, Pa.

## OBITUARIES

**N C Hilton,** executive manager of abrasive wheel, diamond wheel and bowling ball departments of Raybestos-Manhattan, Inc, Manhattan Rubber Div, Passaic, N. J., died March 14, in Glen Ridge, N. J.

**Joseph B Crane,** 66, export manager of Combustion Engineering Co, died at his home in Bridgewater, Conn., on March 9.

**Carlton N Aborn,** 72, president and founder of Laminated Shim Co, Inc, Glenbrook, Conn., died on March 3.

**William A Hiddleson,** 72, at one time general manager of Bristol Gas & Electric Co, later known as East Tennessee Light & Power Co, died at his home in Bristol, Va., on March 8.

**George C Van Vechten** of Rochester, N. Y., manufacturers' agent for power-plant equipment, died March 20 in his home.

**George Trickler,** 91, a retired stationary engineer, died recently in Onondaga General Hospital, Syracuse, N. Y.

**Morris Seymour Hawkins,** 64, who was prominently connected with Princess Anne Power Co, died suddenly in Norfolk, Va., on March 14.

**Edward Speich,** 77, a stationary engineer, died in his home in Buffalo on March 4. He had been employed for 45 years by the Rock Asphalt & Construction Co.

**Albert L Scott,** 67, president of Lockwood Greene Engineers, Inc, New York City, died March 2 in his home at Chappaqua, N. Y.

**James L Waters,** 65, a stationary engineer, died at his home in Buffalo recently. He worked on many important construction projects in and around Buffalo.

**Frank Parker,** 56, chairman, Iron & Steel Products, Inc, Chicago, died in St Luke's Hospital on March 17.

**Charles Edward Van Norman,** 86, chairman of board of Van Norman Co, Springfield, Mass., died recently at his home in Springfield.


*Hard to Control*

**TEMPERATURE OR ATMOSPHERE?**

**Check for SLUDGE**

**Sludge, unseen but ever present, is so common a source of boiler troubles that even experienced engineers sometimes overlook it.**

**Far oftener than is thought, temperature or atmosphere control troubles are caused by sludge in the oil because oil creates sludge as surely as rain creates mud.**

**In high or low pressure boilers—in factories, on railroads or ship lines—once sceptical engineers proved to their satisfaction that a quick, easy way to end sludge is with NCC Fuel Oil Conditioner and Sludge Solvent.**

**NCC entirely eliminates those frequent shutdowns to clean sludge-fouled parts. NCC dissipates water and other impurities. NCC liquefies sludge already formed; cleans and keeps clean dirty tanks, clogged nozzles, clogged feed lines, dirty strainers, carbonized pre-heater coils, dirty burner tips, etc.**

**NCC does not harm metal, is non-inflammable, neutral and acid-free. NCC is a liquid, scientifically prepared sludge solvent; comes to you in a metal drum.**

**Write for NCC Bulletin or send trial order. NCC makes good—or we do. Will you try it? You can't lose.**

**NCC**

**SLUDGE SOLVENT**
**AND FUEL OIL CONDITIONER**

**DISTRIBUTORS! SALESMEN!**
*Choice territories open.*

**NUTMEG CHEMICAL CO.**
**223 State St., New Haven 10, Conn.**

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Controlled, Two Stage Welding by the Westport Method now provides maximum bondage and strength at butt welded pipe joints, without "over-welding," which causes protrusion of weld metal on the inside of the pipe. The patented Westport Method assures a pipe contour smoother on the inside than on the outside, without the use of backing rings, which themselves have many disadvantages. . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today. And remember, while our shop pre-fabricated piping can be made with any type of joint, we believe you'll prefer and specify the Westport, after you read our bulletin.

**WESTPORT JOINT**

*MADE WITHOUT BACKING RINGS BY THE MITCHELL-WESTPORT METHOD

(PATENTED)

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SINCE 1899

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PIPING FABRICATORS AND CONTRACTORS

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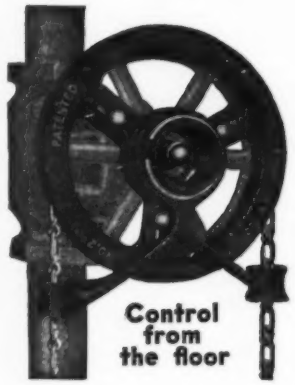


With the Babbit Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

**BABBITT STEAM SPECIALTY CO.**

New Bedford, Mass.

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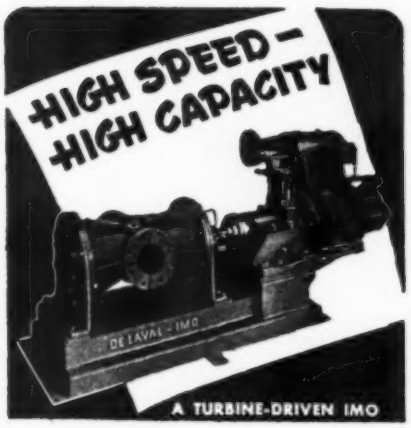


The IMO PUMP provides a maximum of capacity in a minimum of space due to the fact that it can be operated at high speeds connected directly to motor, turbine or other machinery.

Where space is a problem install IMO --the reliable rotary, positive displacement pump having only three moving parts and no gears, pistons, sliding vanes or valves.

For further information send for catalog I-129-P

**IMO** PUMP DIVISION of the
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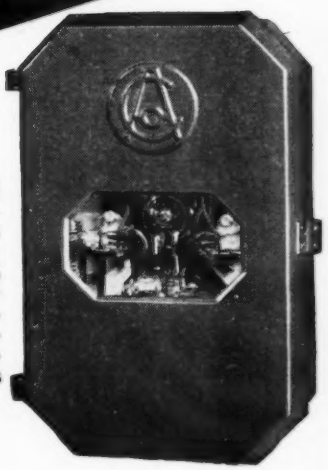
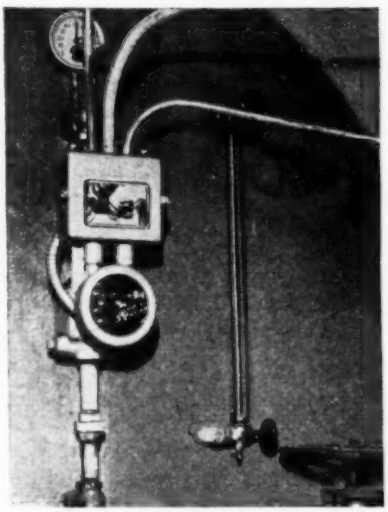
## Accurate CONTROL of WATER LEVEL for Elevated TANKS With AUTOMATIC TANKTROL CONTROL CO.



For controlling remote and nearby elevated tanks by pressure, TANKTROLS are unsurpassed. Handles up to 3 or 4 pumps or alarm circuits. The TANKTROL exclusive two-bellows construction assures accuracy of 1% and full sensitivity over unusually wide operation range. Settings are permanently accurate. Automatic surge and backspin protection. Bulletin T-11 gives complete information—write for it. State requirements and engineering data will be furnished.



## NO WATERLOGGING OR AIR-BINDING In Hydro-Pneumatic (Pressure) Tanks with DUOTROL

The DUOTROL maintains high water level at a fixed point and correctly balances air pressure at that point after each pumping operation. It provides a maximum volume of water with a minimum of pump operation, saving power and reducing wear. Easy to install, stable adjustments. Ask for Bulletin D-6.

**AUTOMATIC CONTROLS** are used by all leading pump manufacturers. When ordering new pumps, specify controls by AUTOMATIC CONTROL CO.

**"AUTOMATIC"** also makes float operated controls: multi-circuit sequence type, multi-circuit program type, float switches, automatic alternators, and many special controls built to specifications.

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1009 UNIVERSITY AVE., SAINT PAUL 4, MINNESOTA

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AGAIN in 1944

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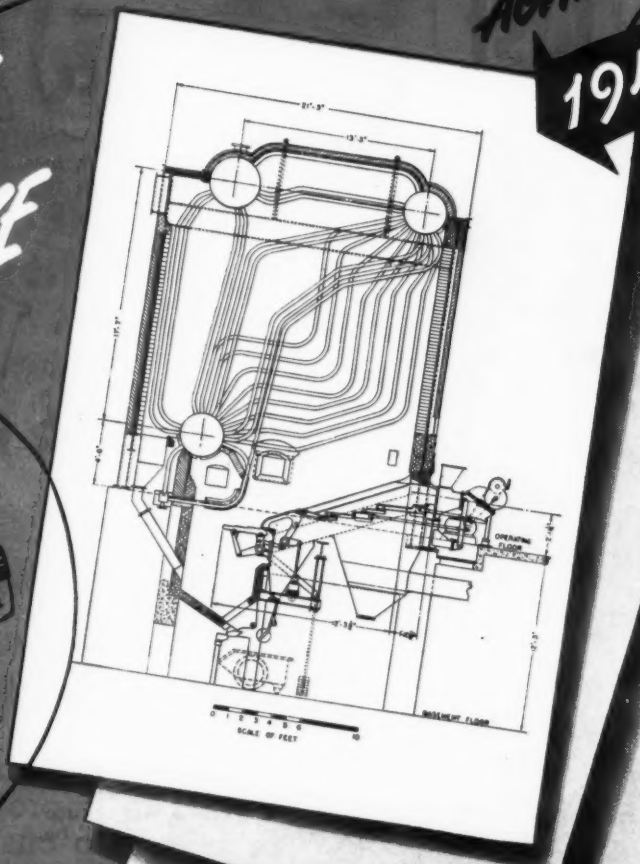
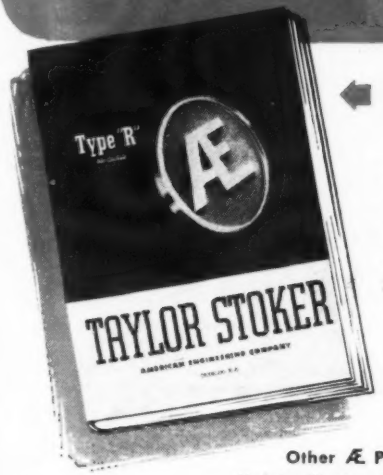


**A world famous manufacturer of drugs has completed its 3rd installation of Æ Taylor Stokers with the type R. This 6 retort, 25 tuyere continuous ash discharge stoker develops 50,000 lbs. per hour continuous steaming capacity.**




## GET THE FACTS ON THE IMPROVED TYPE R

This easy to read 18 page bulletin will quickly bring you up-to-date on the advantages and improvements in stoker operations as provided by the Æ Taylor Stoker. Write for it!

Æ

## TAYLOR STOKER

*AIR-COOLED & WATER-COOLED*

**The Only Underfeed Stoker with *all* these Features IN COMBINATION!**

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

## AMERICAN ENGINEERING COMPANY

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# *Why* they Last and last and Last

The Cochrane Multiport Relief Valve is popular not only because of its remarkable service, but because of its long, trouble free life.

## COCHRANE MULTIPORT RELIEF VALVES

In many plants all over this country Cochrane Multiport Back Pressure Relief Valves have been operating continuously for ten, twenty, twenty-five years—and longer—without replacement of a single part. The care, the skill, the close precision to which this remarkable valve is built, are some of the reasons.

*Write for Publication 4150*

TESTING MULTIPORT VALVE AT FACTORY

**COCHRANE CORP.**
**3106 N. 17th St., Philadelphia, Pa.**

# Engineering Thought THAT MEANS BOWSER

## BETTER SERVICE . . . Longer for

METERING - - FILTERING - - PUMPING
PROPORTIONING - - DISTILLING - - FUELING
STORING AND DISPENSING

Every product built by Bowser is designed to improve some industrial process. To customers this means better products at lower costs.

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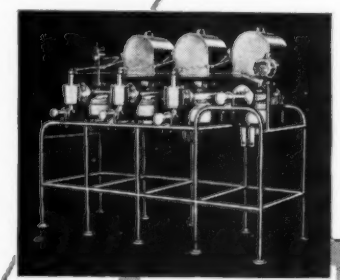
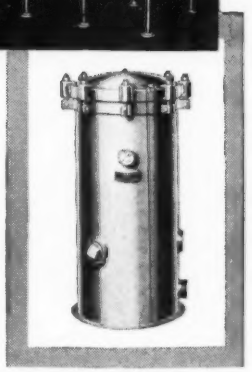


Accurately blends two or more liquids. Patented, precision volumetric control. Assures uniform product . . . eliminates batch mixing. Saves time, labor and storage space.

### EXPENDABLE CARTRIDGE FILTER



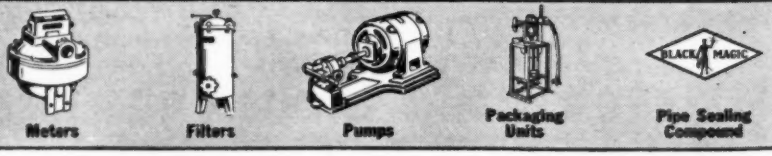
New Bowser development for economical filtration of liquids. Protects costly equipment from dirt or foreign matter. Easily replaceable elements remove particles as small as 2 microns.

*Sales and Service in all principal cities*

**Write BOWSER Inc.**

**1335 Creighton Avenue** **Fort Wayne 2, Indiana**

**LIQUID CONTROL SPECIALISTS SINCE 1885**



# ENGINEERING PROGRESS REPORT # 3

LJUNGSTROM AIR PREHEATER

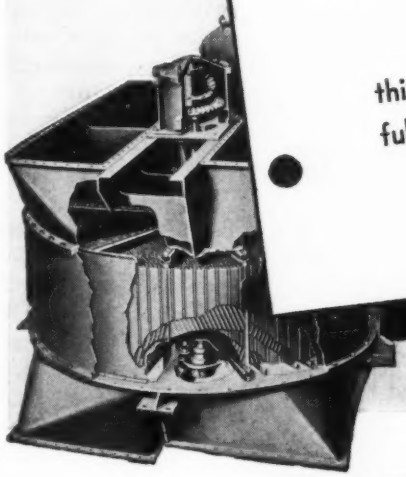
## Measuring Air Flow Across a Ljungstrom

The more modern the plant, the more complicated becomes measuring air flow for combustion of fuel, particularly finding a satisfactory point at which to take measurements.

Draft losses across the superheater and economizer are, in many cases, disturbed by the laning of gases. Methods have been devised whereby the Ljungstrom air preheater provides a normal gas and air flow throughout the load range and it becomes the best place to measure the air and gas flow.

Tests of operation with our new Ljungstrom mass blower have proved its ability to eliminate deposits so that draft loss is stable, by blowing the surface at scheduled intervals. Application tests made on a number of different heaters show that friction losses across the heater are steady in relation to load.

A growing number of large utility companies are using this system of air-flow measurement and their experience fully bears out the results obtained during these tests.



THE

# AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

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for sample can and
complete information.

## USE LUBRI-TASGON

Lubri-Tasgon is unlike ordinary lubricants because it contains a combination of special agents which are necessary to do a thorough lubrication job.

***Lubri-Tasgon contains:***

1. **A PENETRANT that draws it into the finest openings.**
2. **A WETTER which causes it to spread over and wet out the chafing surfaces.**
3. **AN ANTI-OXIDANT to slow up or prevent oxidation and thus prolong the life of the lubricant.**

It reaches the vital spots. It does a thorough lubricating job. It works fast.

**SAMUEL CABOT, Inc., 1601 Oliver Bldg., Boston 9, Mass.**

**LUBRI-TASGON** Penetrates and Lubricates the spots that other oils can't reach.


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*A Special Section on*

**"POWER FIELD STATISTICS AND ANALYSIS"**

Covering new plants—Steam, Diesel and Hydro—Installed since Pearl Harbor, this number will be a valuable guide on plant trends, pressures, temperatures, fuels and other data.


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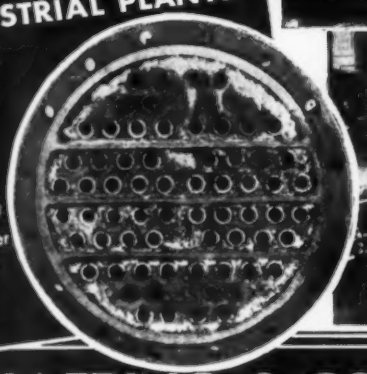
over a period of years have controlled

**CORROSION, SCALE and ALGAE**

in INDUSTRIAL PLANTS



Write on your letterhead for the latest "H-O-H Water Studies"

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## Cut heat loss with RANAREX*

LET Ranarex* show you how to cut heat loss as much as 20%. Install this $CO_2$ indicator and recorder and measure the $CO_2$ in flue gas. Then regulate combustion until the percentage is at precisely the point determined to be correct for your load. This gives you the last bit of power possible from the fuel you burn.

The Ranarex instrument is rugged because it contains no chemicals or fragile parts. Yet it is so sensitive that it gives almost instant readings within 3/10 of 1% accurate. It requires no skill to operate it.

**GET FREE BOOKLET**

Take this first step toward fuel conservation today. Write for free booklet to The Permutit Company, Dept. R5, 330 West 42nd Street, New York 18, N. Y. In Canada: Permutit Company of Canada, Ltd., Montreal.

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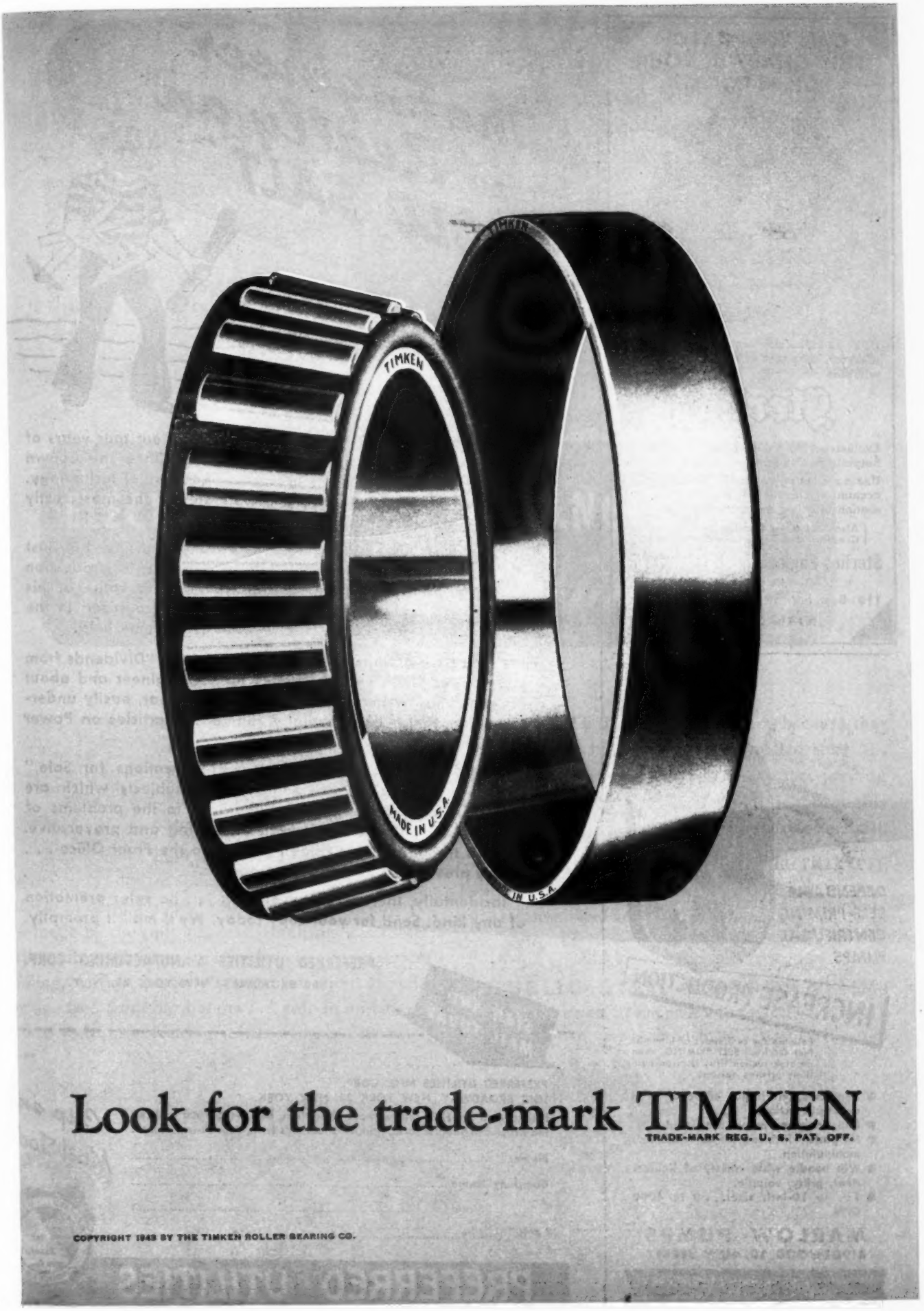


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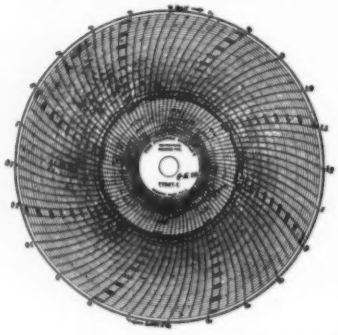
## CAN YOU MATCH THIS CHART IN YOUR BOILER ROOM?



It is being done—by returning high pressure condensate to the boiler room with the

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Exclusive—No Vent—Heat Retaining—Condensate Return System

Use no electricity. No lost operation on account of current failure. Noiseless operation and low maintenance cost.

{ Also lifting — Pumping — Vacuum } { Creating and Vacuum Draining Units }

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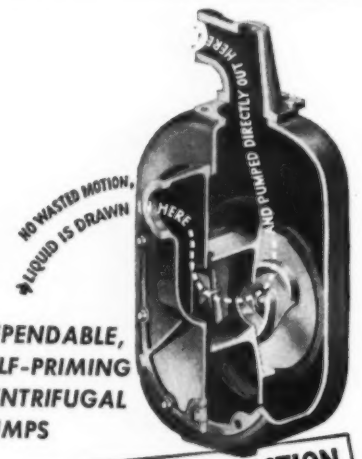
MASSACHUSETTS



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**INCREASE PRODUCTION**

Reliable for continuous or intermittent service. SELF-PRIMING, even on high suction lifts. Has no auxiliary priming devices.

- Combines centrifugal efficiency with automatic action.
- Impeller alone moves the liquid.
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- Will handle wide variety of liquids: clear, gritty, volatile.
- 1½ to 10-inch sizes. 50 to 4000 GPM.

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*Manufacturers of the World's Largest Line of Self-Priming Centrifugal Pumps*



# The Engineer is Really an "OLD SALT"

In "boot training" he may have sweated out four years of intensive study of engineering academics. On a "shakedown cruise" he tackled the basic problems of industrial technology. And now he is a veteran trouble-shooter of the most costly and complex industrial bottlenecks.

Why, then does Management sometimes consider him just a "boot" when it comes to plotting a course of production economy. The answer may be that the profit value of his background and experience is not always recognized in the right places. If this is the case we can be of some help.

**PREFERRED** has released a book called, "Dividends from your Power Plant," which speaks for the engineer and about his problems. Written for Management in clear, easily understood terms, this book contains ten concise articles on Power Plant Engineering.

"Your Engineer is a Gold Mine," "Inventions for Sale," "Steam Isn't Frozen" are some of the subjects which are discussed in its 36 pages. The approach to the problems of Power Plant Engineering is both interesting and provocative. Read it through yourself, then route it to the Front Office . . . it may prove to be quite an "eye-opener."

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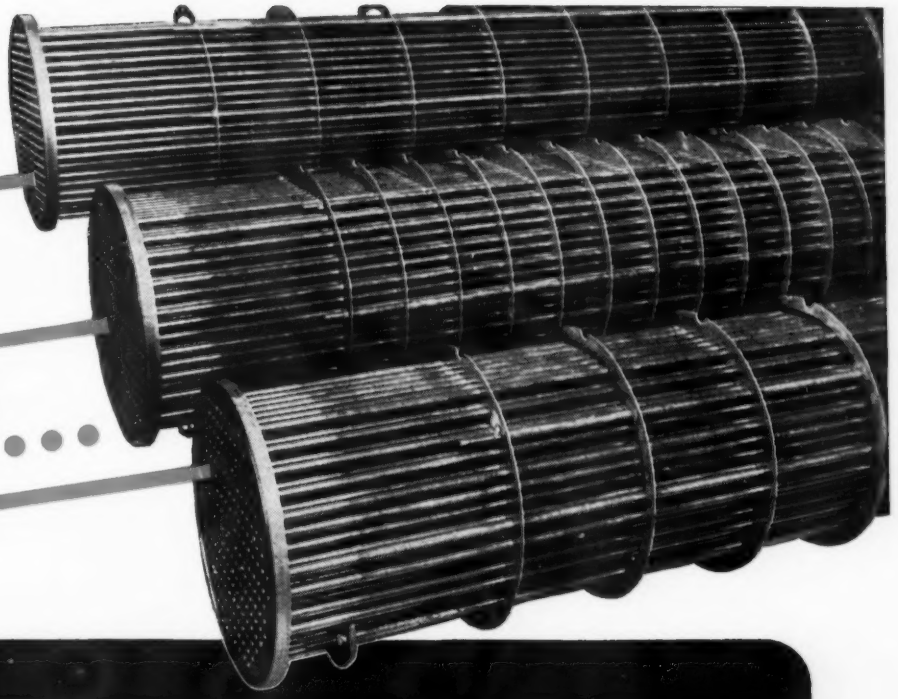

## ELECTRUNITE HEAT EXCHANGER TUBES

## *Go in Faster... Stay in Longer*

It's a start in the right direction when you specify Republic ELECTRUNITE Tubes in new heat exchangers and condensers, and for re-tubing of existing equipment.

ELECTRUNITE Tubes *go in faster,* because they are ALWAYS uniform in diameter, wall thickness and concentricity—made by the only process which insures these qualities throughout every length—*electric resistance welding.* And because tubes are full-normalized, they are free from hard spots . . . roll-in and bead over to tight, non-leaking joints without difficulty.

ELECTRUNITE Tubes *stay in longer,* because they are made from highest quality flat-rolled steel . . . because they are free from scale and failure-inviting scale pits . . . and because each length is thoroughly inspected and rigidly tested before it leaves the mill.

For complete information about ELECTRUNITE Tubes, including a list of sizes and various carbon and stainless steel analyses in which they are available, write to:

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**GUARANTEED**
**TO STAND UP!**

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service. Insure carefree maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
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# SCHERR

**PRECISION INSTRUMENTS**
***For Close Reading***
**HAND TACHOMETERS**

Measure rpm without timing or calculation while held against end of rotating shaft. Any variation in speed caused by belt slipping, overload, etc., is instantly noted. Also have disc for measuring surface speeds in feet per min. Made for speeds from 30 to 12000 changing speed range by new rotating shift mechanism. Other types to 48,000 rpm. Write for details.

**SPEED INDICATORS**

Gives direct readings in rpm in a test requiring only 6 seconds. Needle remains at reading until released by pressure of button. Also measures linear speeds using disc attachment. Two types, ranges to 20,000 rpm. Full data on this and other Scherr speed measuring instruments on request.

GEO. SCHERR CO., Inc.
196-A Lafayette St.
New York 12, N. Y.

*"The Entirely Different Boiler and Engine Treatment*

**In the Palm of Your Hand**

*You*

**Hold the Automatic Solution for Removal and Prevention of boiler scale and corrosion**

**SAND-BANUM**

***does it in Absolute Safety while Your Equipment Operates***

★

***That's the Record for More Than TWENTY YEARS***

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**For**
**Economy**
**Conservation**
**Sustained Operating**
**use**

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and at other convenient points including leading supply houses

*Export Representatives*
PETROLEUM MACHINERY CORP.
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# Faber Wide Range Semi-Mechanical Oil Burners

*Featuring*

Unlimited range of operation without change of burners.

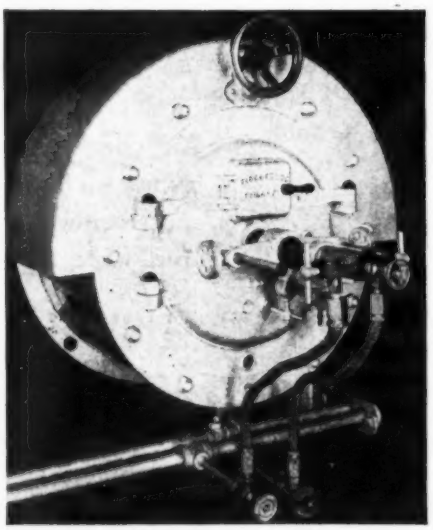
Capable of burning any grade of fuel oil, tar and residue.

Non-clogging.

Low oil pressure with efficient atomization, resulting in a low power consumption.

All heated oil burned, none returned to storage.

Proven by years of successful operation.



Faber Wide Range Semi-Mechanical Burner

***Upon Request Catalog 45***

**FABER ENGINEERING COMPANY**
**PHILADELPHIA 34, PA.**

# More tons of "know-how"—

*ASA Standards cover welding flanges only in sizes through 24", but when a flange becomes part of a pressure vessel, big ones like this are often required. And when you see one of these big ones you can be pretty sure it was made by Taylor Forge because we have been the leading suppliers of such flanges for the manufacturers of pressure vessels for more than 25 years.*

*Of course the problems attending the design and fabrication of boilers and other pressure vessels merge with and overlap those in the piping field. So the knowledge gained in working with boiler manufacturers has made a vital contribution to our knowledge of what constitutes good piping design.*

THE knowledge of piping design and related forging technique accumulated through years of solving all kinds of unusual problems has been drawn upon fully in the design and manufacture of our standard line of WeldELLS and other Taylor Forge fittings for pipe welding. It has resulted in fittings of advanced engineering design with features which add to their strength, service life and convenience—others that speed up the job and lower the cost of pipe installation.

Check the features of WeldELLS listed opposite. Here are features that are not combined in any other welding fittings. Surely you want every one of these features in *your* welding fittings. You get them only in WeldELLS and other Taylor Forge fittings, for in the opinion of those best qualified to know, WeldELLS alone "have everything"!

## WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** —simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

# WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

BONDING STRENGTH MAINTAINED

*throughout entire Temperature Range*

ADAMANT
FIRE BRICK CEMENT

Adamant has an exceptionally high bonding strength, which increases as the temperature rises. Impartial laboratory tests show that Adamant has a bonding strength of 800 lbs. at room temperature; 1270 at 2600° F.

This higher bonding strength protects the structure at the joints, where failure usually begins . . . therefore: linings last longer; production is maintained; repair costs and production materials saved. Write for literature and dealer's name.

BOTFIELD REFRACTORIES CO.
784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

COMING

IN THE JUNE ISSUE

OF POWER

*A Special Section on*

**POWER FIELD STATISTICS AND ANALYSIS**

Covering new plants — Steam, Diesel and Hydro — Installed since Pearl Harbor, this number will be a valuable guide on plant trends, pressures, temperatures, fuels and other data.

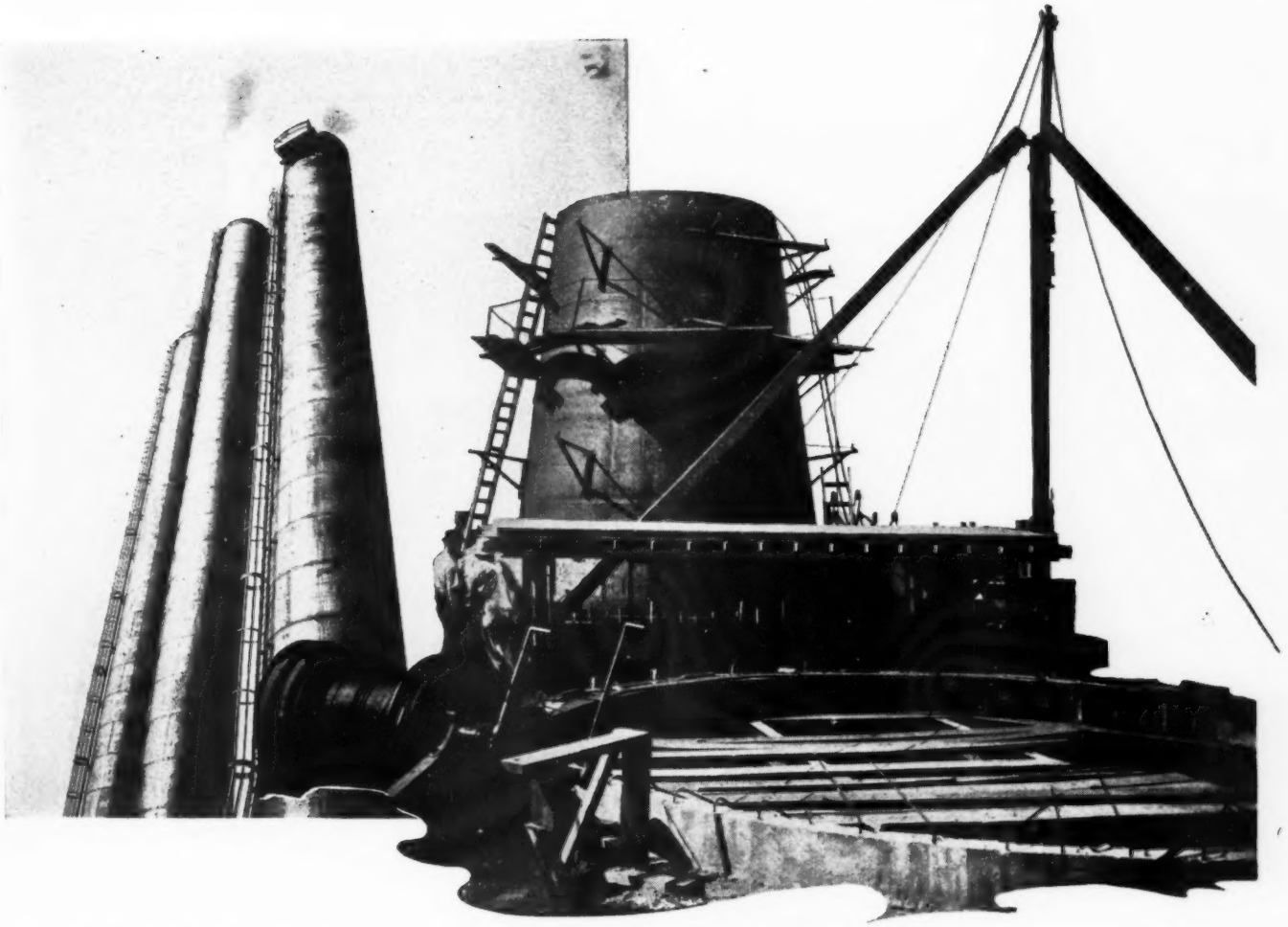
AJAX

FLEXIBLE COUPLINGS

Protecting direct connected machines for 25 years

WRITE FOR YOUR PERSONAL COPY OF THE AJAX DATA BOOK

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, NEW YORK



# GENERAL AMERICAN

## *Self - supporting Steel Stacks*

Every steel stack is especially engineered to meet operating and climatic conditions to assure long service life.

The steel from which the stacks are fabricated is carefully selected with special regard to tensile strength, corrosion resistance, etc. Each section is precision fabricated and before shipment thoroughly inspected to assure freedom from flaws and defects.

Stacks, as well as all other equipment fabricated by General American, shipped in a knocked-down condition, are erected by our Field Erection Department.

**OTHER GENERAL AMERICAN EQUIPMENT**

*Storage Tanks — Water — Oil*
*Steam Drums*
*Standpipes*
*Penstocks*
*Coal Dryers*
*Large Diameter Pipe*

**General American**
TRANSPORTATION CORPORATION
**process equipment • steel and alloy plate fabrication**

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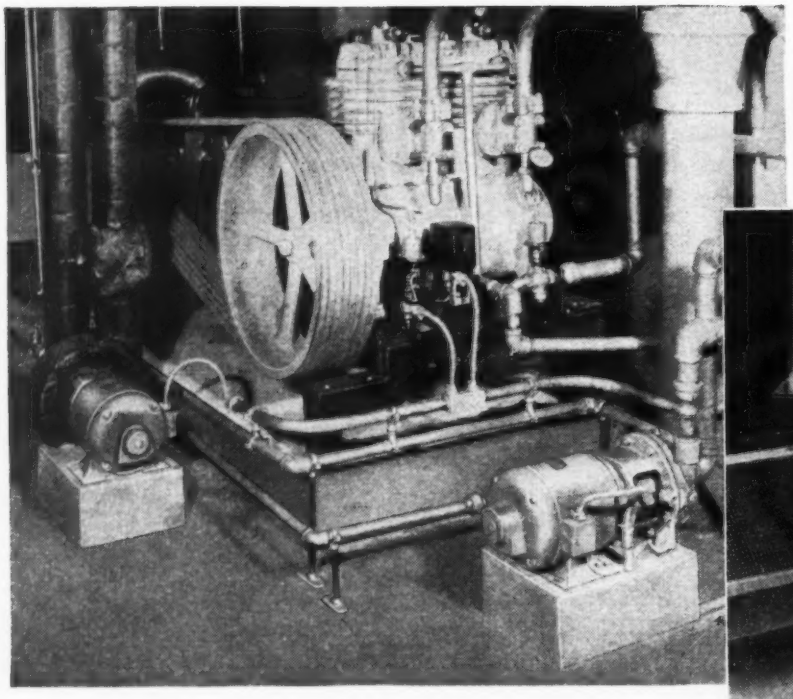
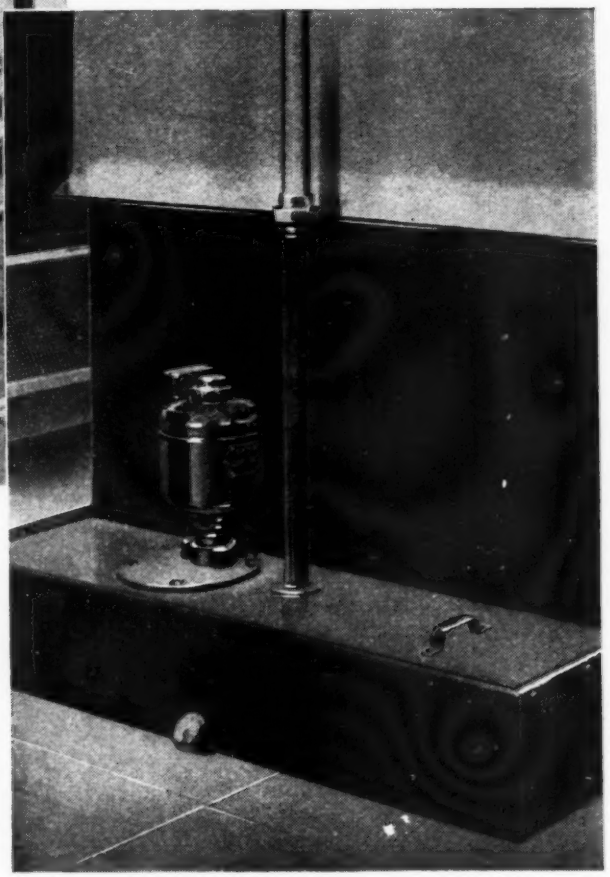
GATX GENERAL AMERICAN

**OFFICES:** Chicago, Louisville, Cleveland, Sharon, Orlando, St. Louis, Salt Lake City, Pittsburgh, San Francisco, Washington, D. C.



Two horizontal 1-hp Motorpumps used in connection with an air conditioning system



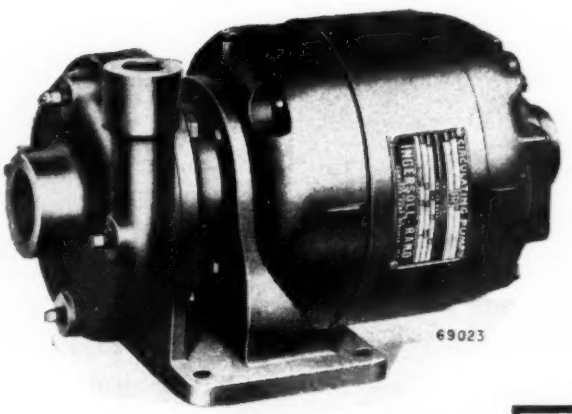
A Model 1KRV submergence-type circulating Motorpump on an evaporative condenser

# MOTOR PUMP GIVES YOU DEPENDABLE HEAT-TRANSFER SERVICE

These compact, self-contained pumping units are designed and built to serve refrigeration equipment of all types—evaporative condensers, economizers, cooling towers, compressors—etc.

The Motorpump line ranges from 1/4 to 40 horsepower, with capacities up to 1800 gallons per minute. Models are available for immersion or sidewall type mounting.

Let our engineers or the nearest I-R distributor give you complete information. Where pumps are an integral part of complete equipment, specify and insist on Ingersoll-Rand Motorpumps.



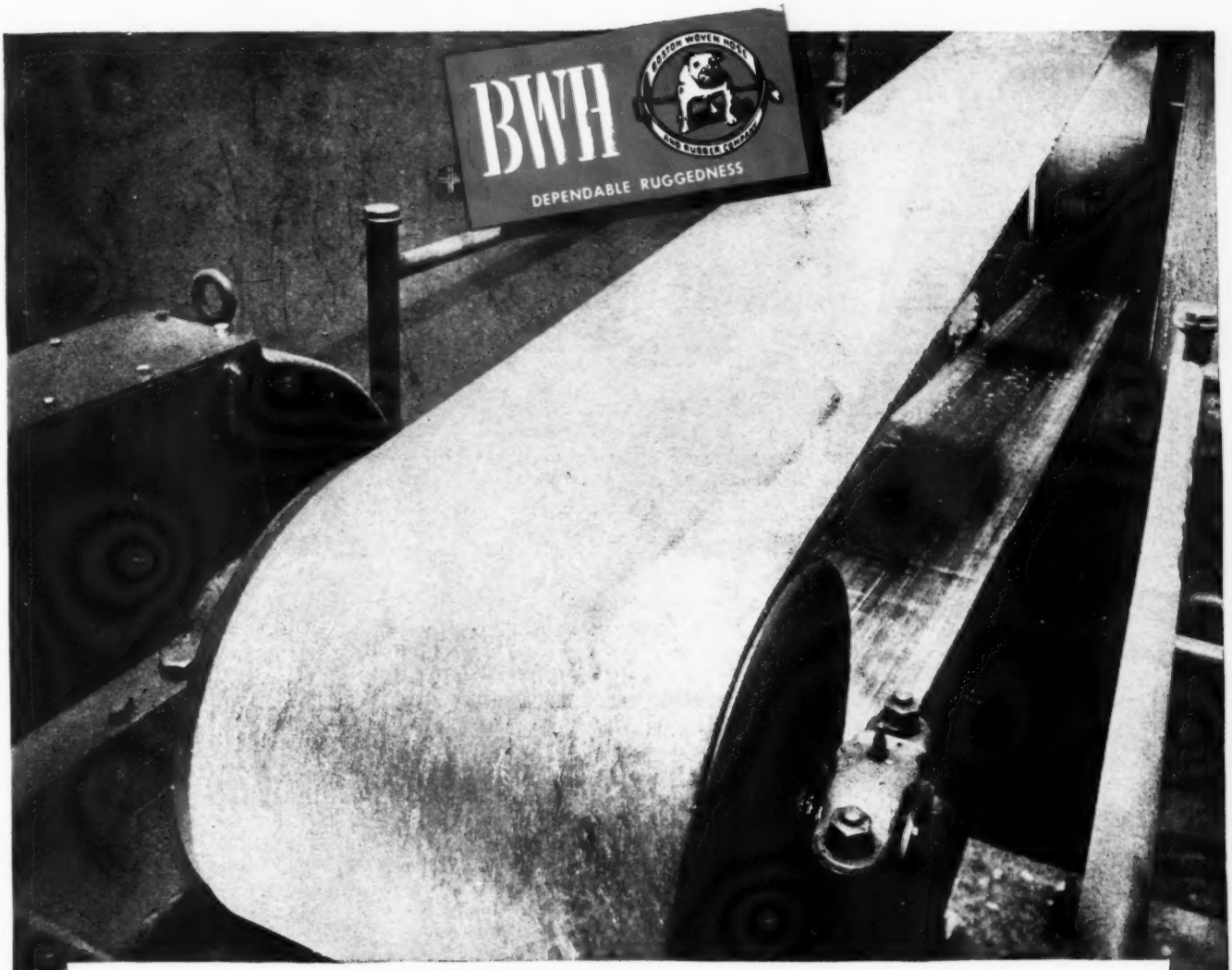

The Model KRVS Motorpump

**Ingersoll-Rand**

CAMERON PUMP DIVISION
11 BROADWAY, NEW YORK 4, N. Y.

9-750

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • OIL AND GAS ENGINES




## 15 YEARS OF RUGGED SERVICE . . . THAT'S THE RECORD OF

# THIS BWH TRANSMISSION BELT!

Day-in and day-out for fifteen years, this tough BWH Transmission Belt has powered a Beater drive in one of America's great paper mills.

Made by the famous Rotocure process of continuous vulcanization — which eliminates potential trouble spots and increases operating life — this belt proved it could take it . . . under high stress . . . difficult operating conditions . . . and on peak load starting.

The success stories of BULL DOG Transmission Belts are matters of record in ore-crushing, refinery, paper, lumber, and textile industries . . . to name a few. So look to BWH for dependable ruggedness . . . BWH distributors for dependable service!

HAVE YOU A JOB WHERE STAMINA COUNTS?
Bring us your toughest problems . . . we're specialists in solving them. Consult your nearest BWH distributor, or write to BWH direct.

## BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in All Principal Cities

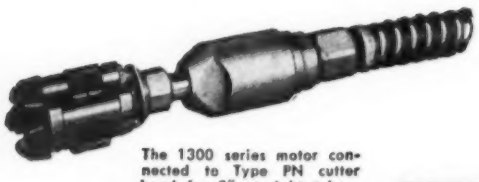
WORKS: CAMBRIDGE, MASS., U. S. A. • P. O. BOX 1071, BOSTON 3, MASS.

# Quick DEATH to boiler scale

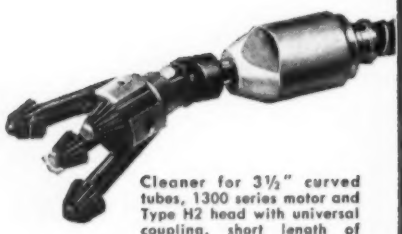
For curved tubes a short-bodied 1300 series motor is used with universal joint between motor and Quick Repair head and a short length of hose at the rear to give flexibility.

●

Write today for the Elliott boiler tube cleaner bulletin. If you have an unusually tricky or difficult tube cleaning problem, consult with the nearest Elliott specialist. We will put you in touch.



The 1300 series motor connected to Type PN cutter head for 3" straight tubes.



Cleaner for 3½" curved tubes, 1300 series motor and Type H2 head with universal coupling, short length of hose at rear of motor.

1300 series cleaner for 3" curved tubes with universal joint and drill, short length of hose connected to rear of motor.

1300 series motor equipped with vibrator head for use in removing scale from the outside of fire tubes.

They call them scale-killers in many boiler rooms. These Elliott (Lagonda Type) 1300 series tube cleaners zip into action and quickly run through scale-clogged tubes leaving them clean as a whistle and ready for business again.

Tube cleaning is a one-pass job with an Elliott cleaner. No need to run it through a second time. And no need to run the motor while the cleaner is being pulled back. Simply haul back and get going on the next tube.

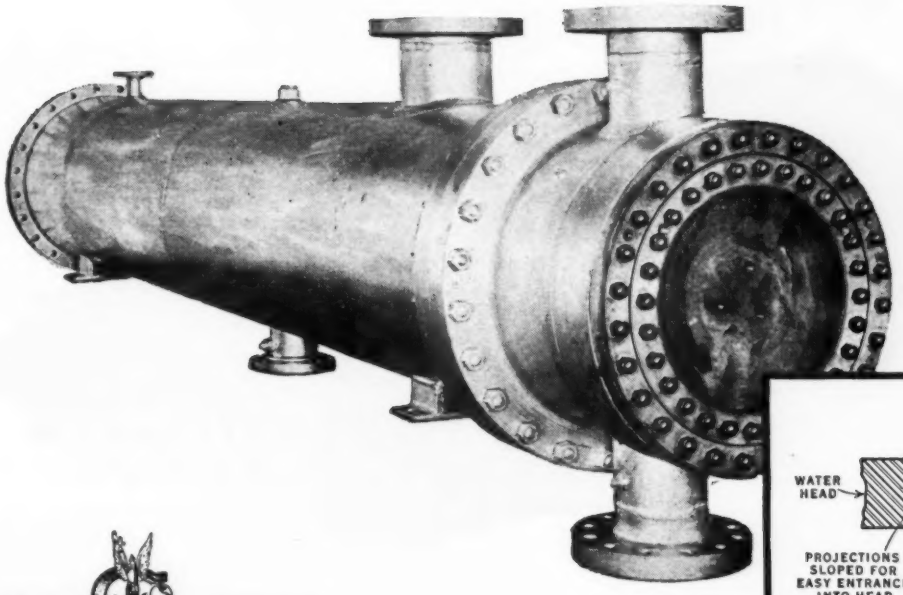
Maintenance men like the way Elliott cleaners operate. They know these cleaners help them get through with the job faster and easier. They like the refinements that make these cleaners swift, powerful — and troublefree.

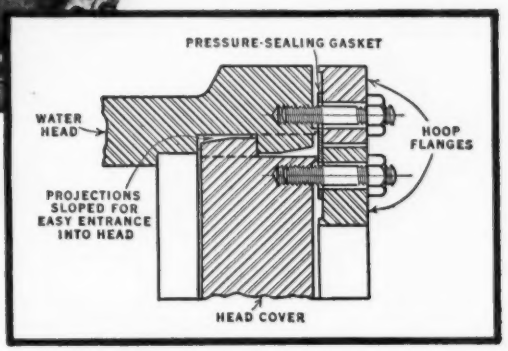
Rugged cutterheads, all-over lubrication system (including front bearing), super-efficient motor and a streamlined body that gets around tube turns, help make Elliott tube cleaners the kind to have in your own boiler room. Write today for fully detailed bulletin.

**ELLIOTT COMPANY**
LAGONDA DIVISION, SPRINGFIELD, O.
District Offices in Principal Cities
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.

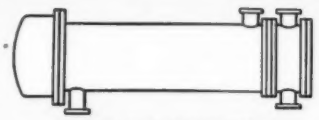
Y-257

# ELLIOTT 1300 SERIES TUBE CLEANERS





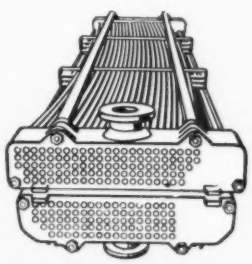

**ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS**



**SHELL and BARE TUBE**
Heaters, Coolers, Condensers, Heat Exchangers

**G-FIN**
Longitudinal-finned elements for greater heat conductivity

**K-FIN**
Helical-finned elements for vapors and gases



**BENTUBE EVAPORATOR**
Scale-shedding Elements

**TUBEFLO SECTIONS**
Non-clogging design for residuum and other dirty fluids

# THIS EXTRACTION STEAM HEATER HEAD

## *has 4 important advantages*

***For high-pressure service, the G-R Type L Heater Head design provides the following 4 outstanding benefits not obtainable in any other designs.***

### NO HEAVY BOLTS

The "breech block" arrangement of water head and cover transmits the hydraulic load to the barrel, and requires only a light pressure-sealing member to maintain a tight joint.

### VISIBLE PRESSURE SEAL

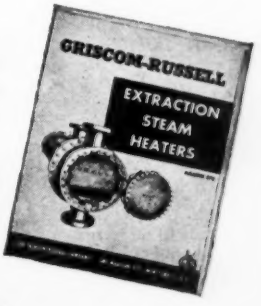
The pressure sealing joint is visible for inspection.

### ACCESSIBLE GASKET

Gasket pressure is easily adjusted without dismantling the water head cover.

### READILY REMOVABLE HEAD COVER

The water head cover is removed or replaced by a single tool, and by simply rotating it through a small angle equivalent to the width of the engaging "breech block" projections.




***These advantages and the other distinctive features of all the G-R Extraction Steam Heater designs for various pressures and capacities are described in Bulletin 278, which will be sent on request.***

**THE GRISCOM-RUSSELL CO., 285 Madison Ave., New York 17, N. Y.**

# GRISCOM-RUSSELL

*Pioneers in Heat Transfer Apparatus*

*Train up a child in the way he should go;*
*and when he is old he will not depart from it.*
—PROVERB

# Direct the flexing of a corrugated expansion joint in the way it should go; and even when it is old it will not depart from it.

*If it's Badger made it's got something*

BADGER Self-equalizing Corrugated Expansion Joints are the only joints for high-temperature and high-pressure lines in which the flexing movement and stresses are definitely directed in such a way that:

> *All the corrugations share the stress load equally;*
> *All points of the surface of each corrugation share its individual load equally.*

Badger ALL-CURVE Directed Flexing Rings and Badger ALL-CURVE corrugations are the combination that does the job. Excessive stresses can't pile up locally in pockets, corners or junctions. Nor unevenly among the corrugations. They can't "blow the joint"—endanger the line or shorten the life of these superbly engineered joints.

Special Badger methods of forming the corrugations from a single piece of tubing contribute further to the strength of these joints; and a special Badger heat treatment preserves their flexing qualities.

Each corrugation affords a definite standard of traverse, according to its depth and the diameter of the joint. This makes it easy to determine the number of corrugations needed to absorb the maximum longitudinal expansion of any length of line.

Once you've installed dependable, long-lasting Badger Corrugated Joints with DIRECTED FLEXING Rings, your pipe-expansion problems are solved for the life of the line.

***MADE IN COPPER, STAINLESS STEEL AND OTHER ALLOYS*** — Copper for normal pressures and temperatures; Stainless Steel and other alloys for higher requirements—and where corrosion is a problem. Single or multiple corrugations—for traverses from a fraction of an inch upward. Also made in Non-equalizing type (without rings) for uses that do not require added protection. SEND FOR BULLETIN NO. 100 (*Self-equalizing*) or No. 200 (*Non-equalizing*).

# Badger

**E. B. BADGER & SONS CO., 75 Pitts Street, Boston 14, Mass.**
*AGENTS IN PRINCIPAL CITIES*

PACKLESS CORRUGATED EXPANSION JOINTS

# Wire ahead FOR FULL PRODUCTION

WHEN ELECTRIC POWER costs so little . . . and other costs are rising, no management can afford to overlook adequate wiring.

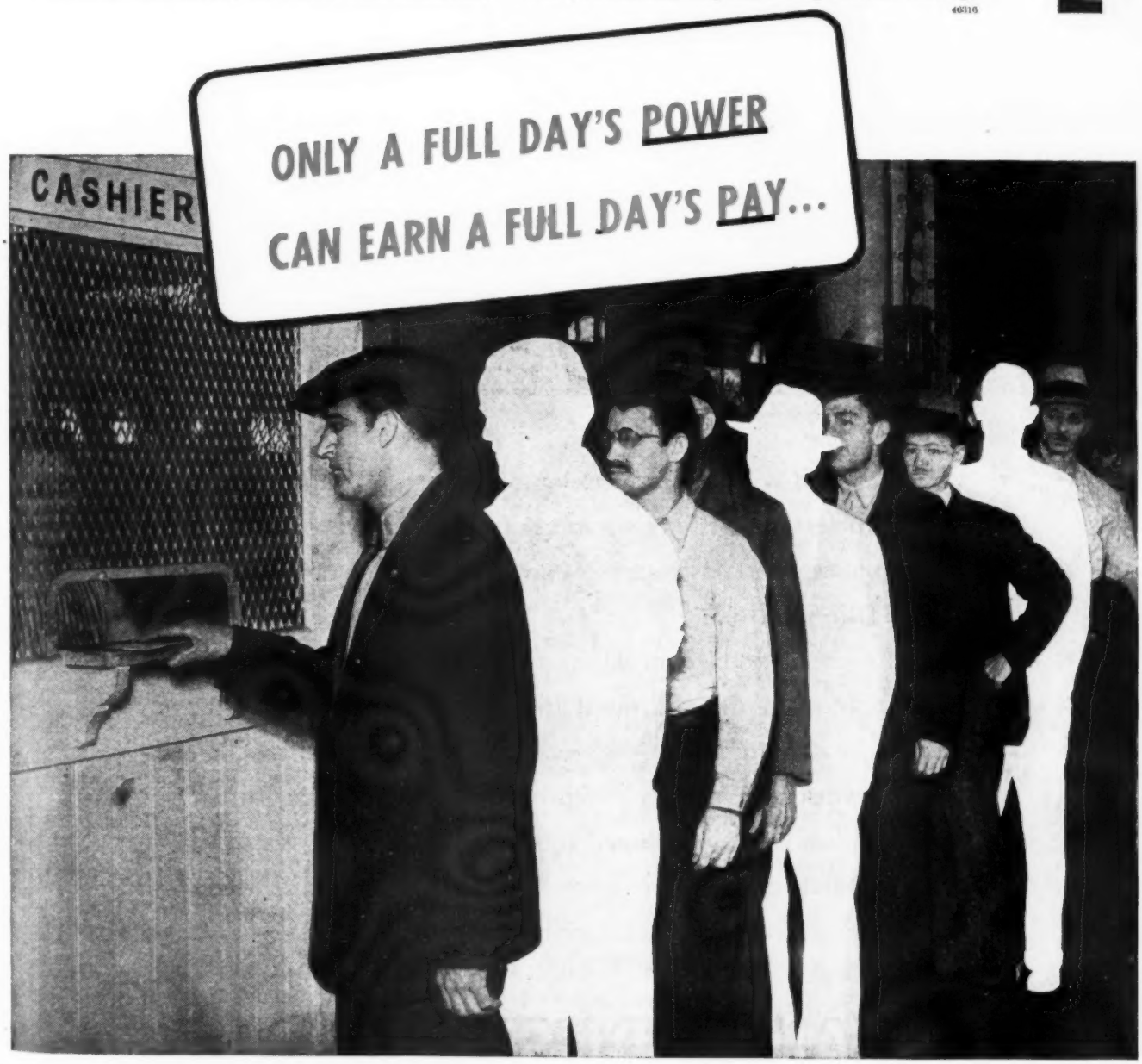
Obsolete wiring, overtaxed wiring can reduce machine efficiency, and hence worker efficiency, from 25 to 50 per cent.

For, when power fails, the productivity of the most ambitious, the most conscientious, the most skilled workmen you have must drop accordingly.

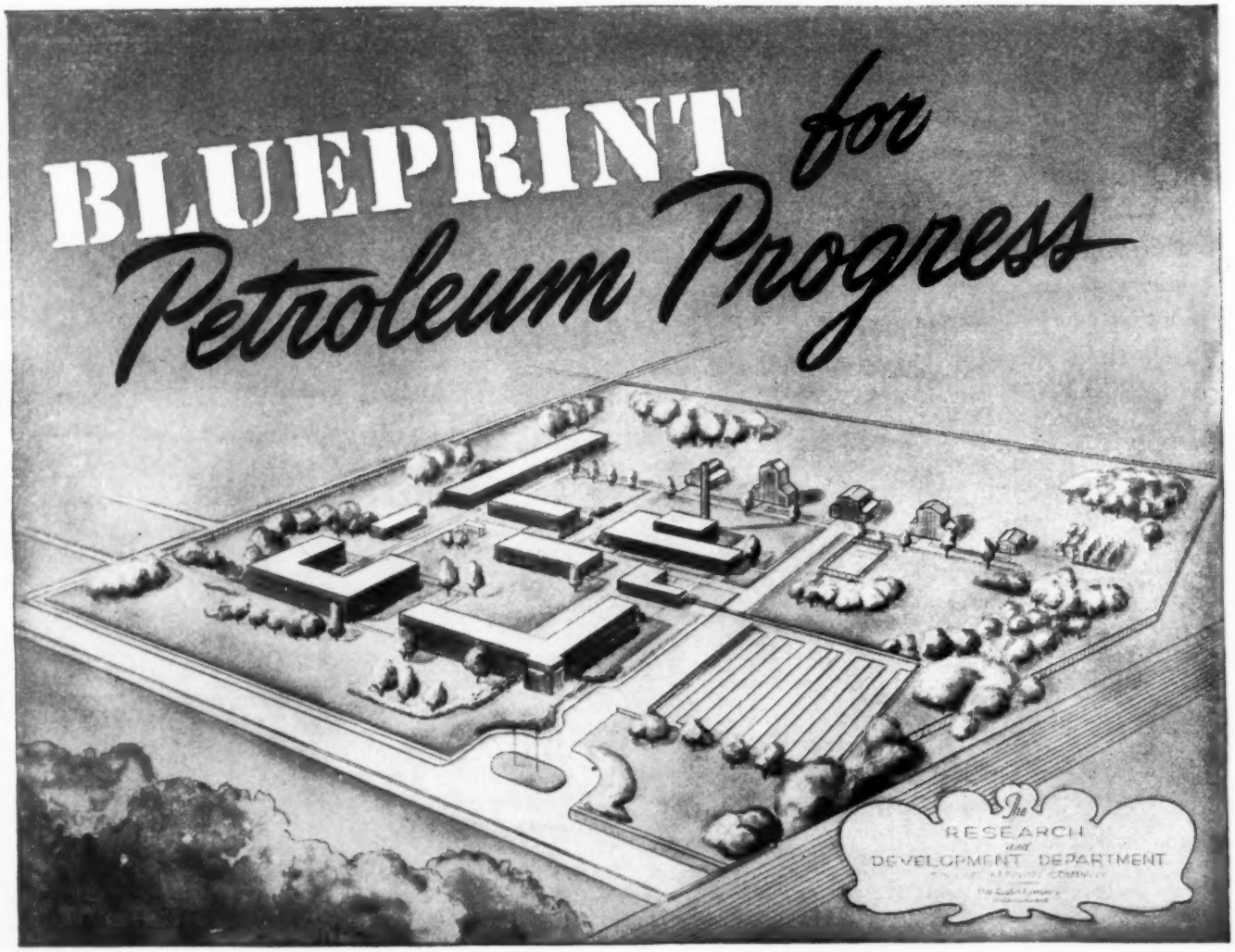
Talk over your wiring problem *now* with your plant power engineer, your consulting engineer, electrical contractor or power salesman. It may save expensive alterations later.

These men *know*, as you suspect, that postwar production depends on postwar wiring.

46316




ANACONDA **ANACONDA WIRE & CABLE COMPANY**




MOVING ahead with the resumption of peace-time industrial activity, Sinclair assures its customers of still greater product quality and performance with construction of an elaborate new research center at Harvey, Illinois.

In this great petroleum laboratory, recognized technological experts will have at their disposal the very latest facilities for the solution of the most difficult and specific lubrication problems. From the research work here, you may expect consistently top performance from Sinclair lubricants developed for every type of industrial use.

This research center is evidence that Sinclair means it when it says "Better Products . . . Better Service."

**SINCLAIR INDUSTRIAL OILS**

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

# For Pressure-tight Circuits

# PARKER

## VALVES AND COUPLINGS

For fewer leaks, for lower pressure drop, specify Parker Valves and Couplings. They're specially designed to simplify hydraulic power and fluid transmission tubing systems.

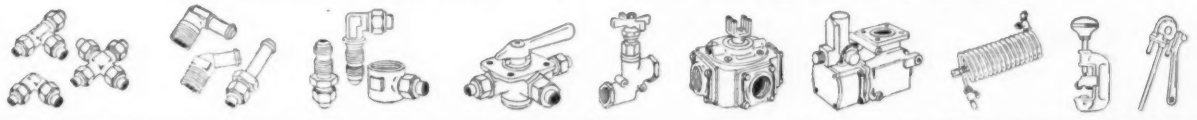
Parker Valves are light, yet strong. They'll give you smoother flow. And PARKER TRIPLE COUPLINGS complete the circuit with leakproof, vibration-protected joints. You'll have a system that's easier to install, safer to operate and quicker to service.

Stocks of industrial valves, couplings and fittings are now available at your distributor's and at Parker warehouses. Send for our catalogs. The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio. In Canada, Railway & Power Engineering Corporation, Ltd., Montreal, P. Q.

Look for this famous trade mark. It's your assurance of trouble-free couplings and valves. These initials, ALP, are the initials of our founder, A. L. Parker. Let them serve to remind you that for Alignment, Leak-protection and Pressure-tightness you can't beat Parker Valves and Couplings ... the couplings with the famous patented Parker Triple construction.

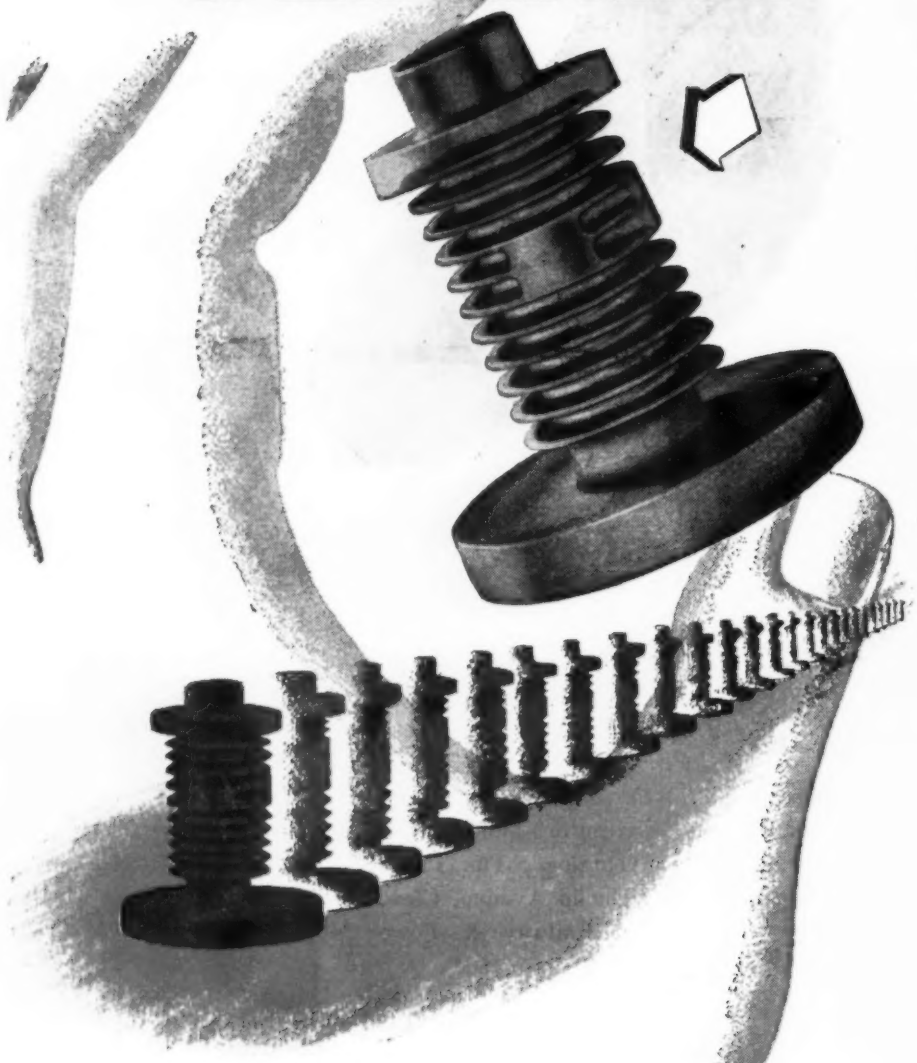
## THE PARKER APPLIANCE CO.

CLEVELAND • LOS ANGELES



FLUID POWER PRODUCTS FOR ALL INDUSTRY

# DESCENDED FROM A LONG LINE OF ABLE PERFORMERS



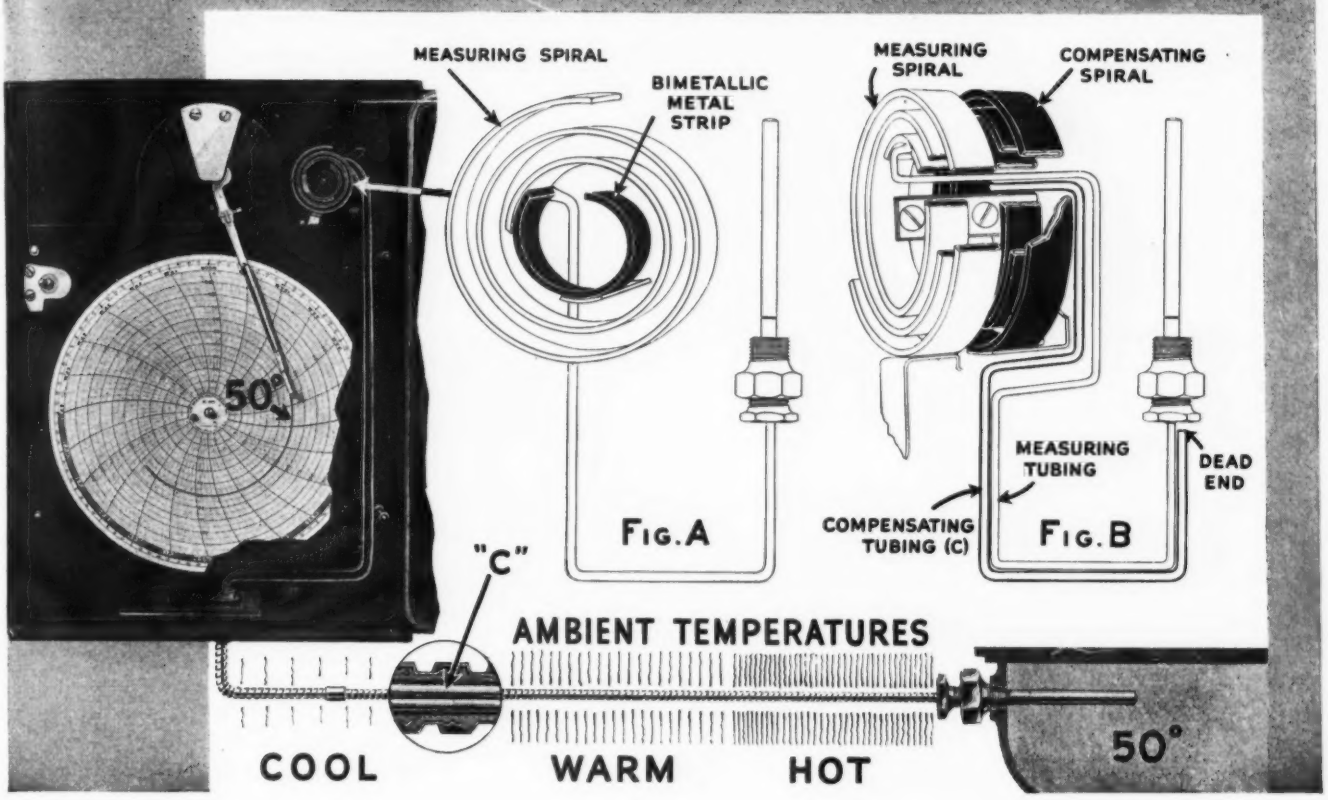
Behind this Sivyer casting is the experience of nearly 38 foundry years. Before it is the promise that it will do its job long and well—will provide the kind of service which the skill from these casting years has put into it.

Men long experienced in every phase of foundry practice carefully watch over the making of all Sivyer Steel castings. And the latest in scientific testing and control work with these men to the end of finished products embracing greater integrity of metal . . . greater dimensional accuracy.

Whatever your steel casting requirements, consult Sivyer. You'll find that the Sivyer diamond ◈ — means castings worth looking for.

SIVYER STEEL CASTING COMPANY
MILWAUKEE CHICAGO

# Compensated for AMBIENT TEMPERATURES




PRECISION Recording or Indicating of true bulb temperature is a built-in feature of Brown Thermometers.

Errors due to ambient temperatures surrounding instrument case and capillary system are compensated for at the point of fluctuation.

Brown *Mercury* filled Thermometers (Fig. B) have two spiral actuating elements and two capillary tubes. The *first*, or measuring spiral is connected to the bulb through its capillary in the usual manner. The *second*, or compensating spiral, is connected to its capillary which is dead ended at the bulb.

The two spirals expand in opposite directions and are connected directly to the pen shaft. Therefore, a change in temperature within the instrument case itself or at points along the capillary tubing will affect both actuating spirals to the same degree and the results will exactly neutralize each other. Thus, errors are eliminated.

Ambient temperatures have a negligible effect on Brown Gas *filled* Thermometers. Case compensation all that is required for precision measurement is accomplished by a bimetallic strip shown in (Fig. A).

When you install Brown Thermometers you can rely on their precision—be confident of their dependability.

## Other features are fully described in Catalog 6706

Write for a copy, THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Company, 4490 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada: London, England: Stockholm, Sweden: Amsterdam, Holland.

**MH BROWN THERMOMETERS**
INDICATING....RECORDING....CONTROLLING

# GETS THE *OK* OF THE MAN ON THE JOB!

## 3-WAY THREADER

### ...Better All-Ways!

Compactly designed—the Toledo 3-Way Threader is lightest, smallest and easiest to operate of all 3-way tools! No. 30 threads $\frac{3}{8}$" to $\frac{3}{4}$" pipe, wt. 4-$\frac{3}{4}$ lb. No. 31 threads $\frac{1}{2}$" to 1" pipe, wt. 7 lb. Efficient...dependable.

"TOLEDO"

Sure he's smiling—the *right* pipe tools mean satisfaction all around!

Contractors and mechanics today can count on "smooth going" from start to finish—with easy-threading TOLEDO Pipe Tools on the job. These accurate, dependable tools are engineered to do a better job and help you *cut costs!* Preferred by experienced hands for nearly half a century.

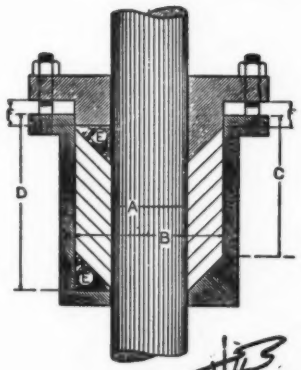
In these busy days of building in residential, commercial and industrial fields . . . gear your pipe fitting to greater efficiency. Specify TOLEDO for unbeatable performance! The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Building.

RELY ON THE LEADER...

# TOLEDO

FOR PRECISION PIPE TOOLS

*The Tougher the Service the Better the Proof . . . .*




## *Self-Setting* PACKING

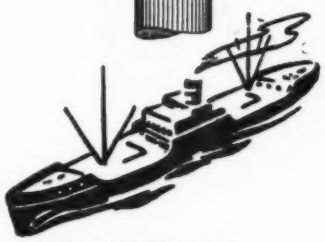
To use Q-P Self-Setting Packing is to play safe with those difficult applications which are frequently a source of trouble with ordinary packing, because Q-P is the packing especially designed for meeting tough operating conditions.

In turbine service, for example, Q-P has a long record of successful performance. Used by leading turbine builders in their equipment, operators have found it the packing to depend on for replacements, and for utmost assurance against shut-down.

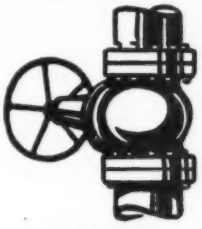
There are countless other performance-proved applications where Q-P Self-Setting Packing, once used, is fast becoming standardized on for both new equipment and for maintenance, because of its better performance, longer lasting qualities and less frequent attention. It is recommended for steam, water, compressed air, ammonia, fuel oils, gas, gasoline or oils.

The effectiveness of QP Packing is achieved through its unique features of design. In operation, the pressure of the fluid being handled deflects the edges of the packing rings in such a way as to form a perfect seal, automatically adjusting itself to exact rod diameter and reducing rod wear to a minimum.

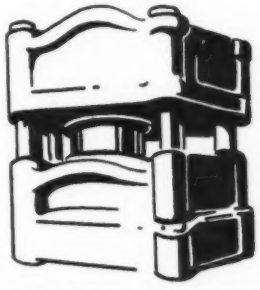
***Outline your packing problem and let us show you how you can meet it most effectively with Q-P Self-Setting Packing.***



TELEMOTORS-VALVE



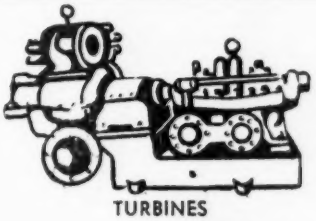
VALVES



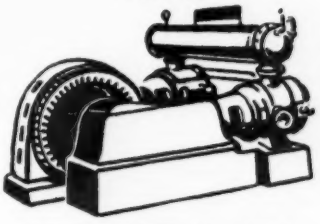
HYDRAULIC EQUIPMENT

*Sales Representatives*

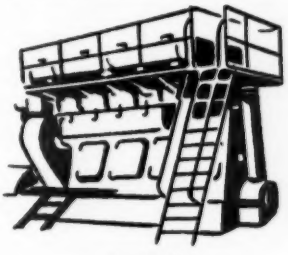
Belmont Supply Co., Waltham 54, Mass.
Chapman Industrial Supply Co., Los Angeles 13, Calif.
Darling Bros., Ltd., Montreal Canada
A. G. Day, South Braintree, 85 Mass.
Hercules Eqpt. & Rubber Co., San Francisco, Calif.
Industrial Equipment Co., Charleston 23, West Va.
Kellogg Appliances Co., Philadelphia 44, Pa.
Kindred Appliances Co. Inc., New York 7, N. Y.
Marine & Industrial Supply Co., Seattle 4, Wash.



TURBINES



COMPPRESSOR (Ammonia)



DIESELS

EXPANSION JOINTS

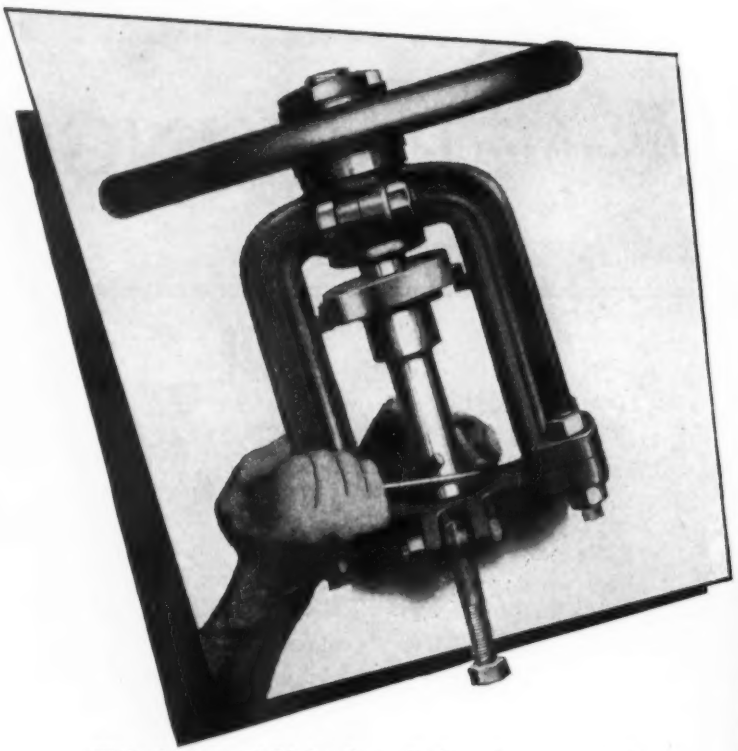
*Sales Representatives*

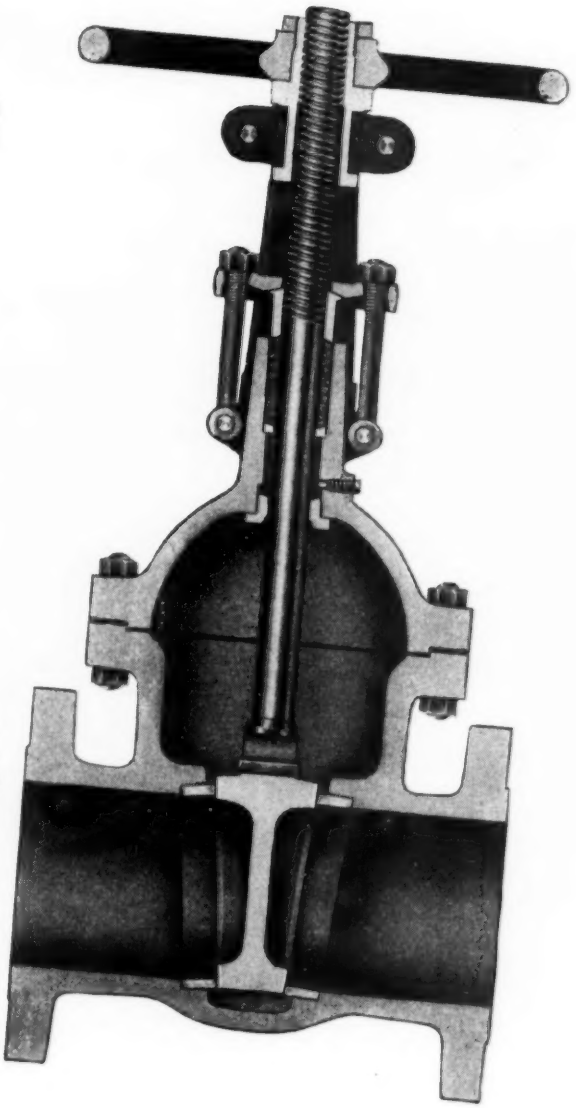
Meyer Ekstrom Co., Chicago 6, Ill.
Ellis W. Morse Co., Binghamton, N. Y.
Harry A. Neff, Fort Wayne 3, Ind.
Paramount Packing Co., Baltimore, Md.
Rex F. Rorabacher, Grand Rapids 7, Mich.
John W. Ruhstorfer, Detroit 8, Mich.
Elliott M. Sergeant, Niagara Falls, N. Y.
Peter J. Soulen, Milwaukee, Wis.
The Stephan Co., Cleveland 3, Ohio
Tutein Equip. Co., Pittsburgh 5, Pa.
Uhrich Supply Co., Kansas City 16, Mo.

*The*
**Q-P MANUFACTURING COMPANY**
NEEDHAM HEIGHTS, MASS.

# You don't need 3 hands

## *to repack this valve!*





This OIC Steel Valve has all the advantages of 2-piece gland-and-follower construction PLUS the exclusive LIFT-LOK feature. When repacking is needed the maintenance man lifts gland and follower as a single unit. He turns the gland slightly so that its cam-shaped rim rests on two lugs on the yoke. Then he repacks easily and quickly without fumbling or hindrance.

This is *only one* of many ways we have found to give you more for your money with OIC Valves. Your OIC distributor has the full story.

**The LIFT-LOK is one of the standard features of OIC Steel Valves. Your OIC Distributor can give you detailed information on special advantages in OIC Iron and Bronze valves for all applications.**

THE OHIO INJECTOR COMPANY

OIC **VALVES**

WADSWORTH • OHIO

# Why Gadsby would rather garden

RAIN and hot sun are welcome when he's trying to coax up lettuce and early peas. *But down at his factory they ruin his day!* Perspiring employees leave finger-prints on highly polished surfaces. Fluctuating temperatures make it hard to "mike" metals accurately. Everybody is uncomfortable and cranky.

These are some of the troubles the Carrier kind of year-round air conditioning overcomes. Scientific temperature and humidity control is improving quality and stepping up production in machine shops, textile mills, rubber factories and a long, varied list of other industries. Carrier air conditioning *makes weather to order*, keeps out wind and troublesome dust. Comfortable air, winter and summer, lifts employee morale, reduces absenteeism.

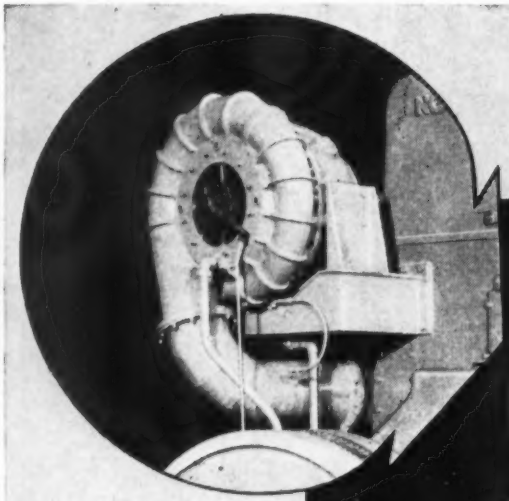
The *right kind* of air conditioning takes years of experience and intimate knowledge of industrial processes. That's why leading manufacturers in so many fields turn to Carrier. *Air conditioning was created by Carrier* and Carrier engineers have contributed every major improvement. Its experienced technical men are ready to talk over your particular needs. Why not consult them? There's no obligation. Carrier Corporation, Syracuse, New York.

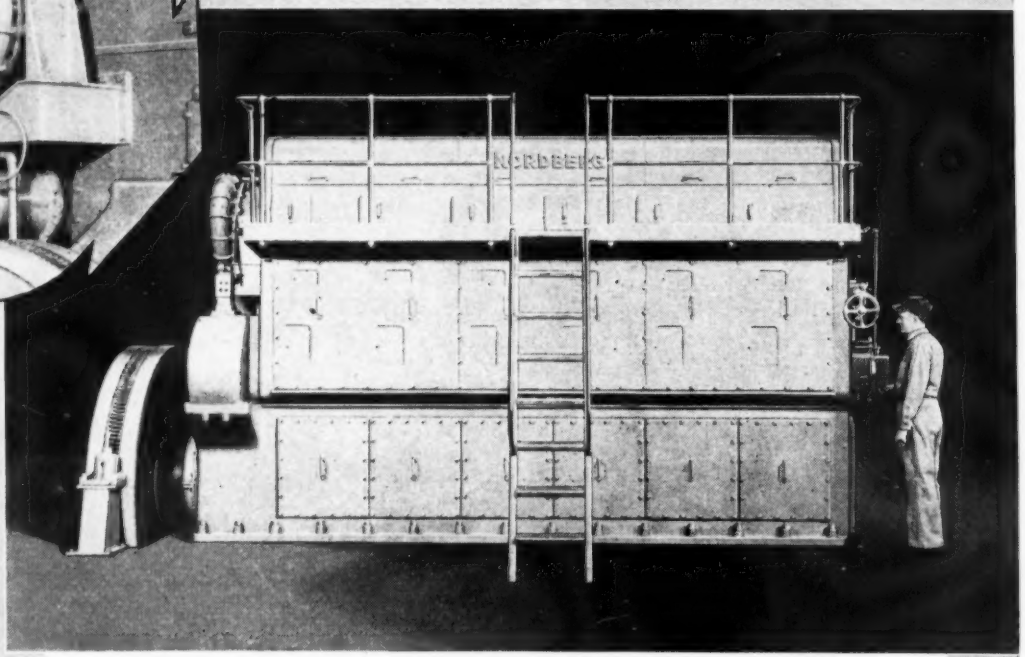
**Carrier**

**AIR CONDITIONING**
**REFRIGERATION**
**INDUSTRIAL HEATING**

# The Improved
# NORDBERG 4 Cycle DIESEL

## Supercharged and Non-Supercharged





Nordberg four-cycle engines are built in sizes up to 1600 horsepower. This six cylinder, 1200 horsepower engine is supercharged.

The improved Type FS-16 Nordberg Diesel engine is the result of thirty-five years of experience in building Diesel engines. Nordberg's first four-cycle engine was placed in operation in 1933. The first four-cycle supercharged engine in 1939.

Nordberg four-cycle engines are noteworthy for their simplicity of design, sturdy construction and accessibility to working parts though fully enclosed. These and other features combine in achieving dependable and economical performance, minimum maintenance and long life.

When in need of Diesel power, let Nordberg engineers acquaint you with the merits of Nordberg Diesel engines.

**NORDBERG MFG. CO., MILWAUKEE 7, WIS.**

**NORDBERG**
**DIESEL ENGINES**

# THERE ARE DEFINITE REASONS FOR YOUR REPUBLIC DISTRIBUTOR'S *Leading Position* IN HIS FIELD

Republic's plant produces Mechanical Rubber Products exclusively.

YOUR REPUBLIC DISTRIBUTOR'S ability to provide prompt delivery and complete technical service on your belting and hose needs stems from a factory-distributor relationship which is as exemplary today as it was in the earlier struggling days of the independent jobber. Republic pioneered in the adoption of the mill supply house system as an exclusive outlet. The company backed its conclusion that the distributor was the key to greater economy in the flow of goods from factory to consumer by drafting and publishing . . . in 1923 . . . its 5-Point Distributor Policy.

The Policy became, as it stands today, an unalterable guide for complete cooperation between Republic and its nationwide distributor network. Then, as now, Republic was committed to provide a complete line of top quality rubber products, freedom from factory competition, technical training and assistance, other selling and servicing helps. In return, your Republic Distributor has been able to operate his organization at maximum efficiency . . . furnish the type of service which saves you time, trouble and expense on mechanical rubber requirements.

WE ARE PARTICIPANTS IN THE OWNERSHIP AND OPERATION OF NATIONAL SYNTHETIC RUBBER CORPORATION

# REPUBLIC RUBBER

DIVISION

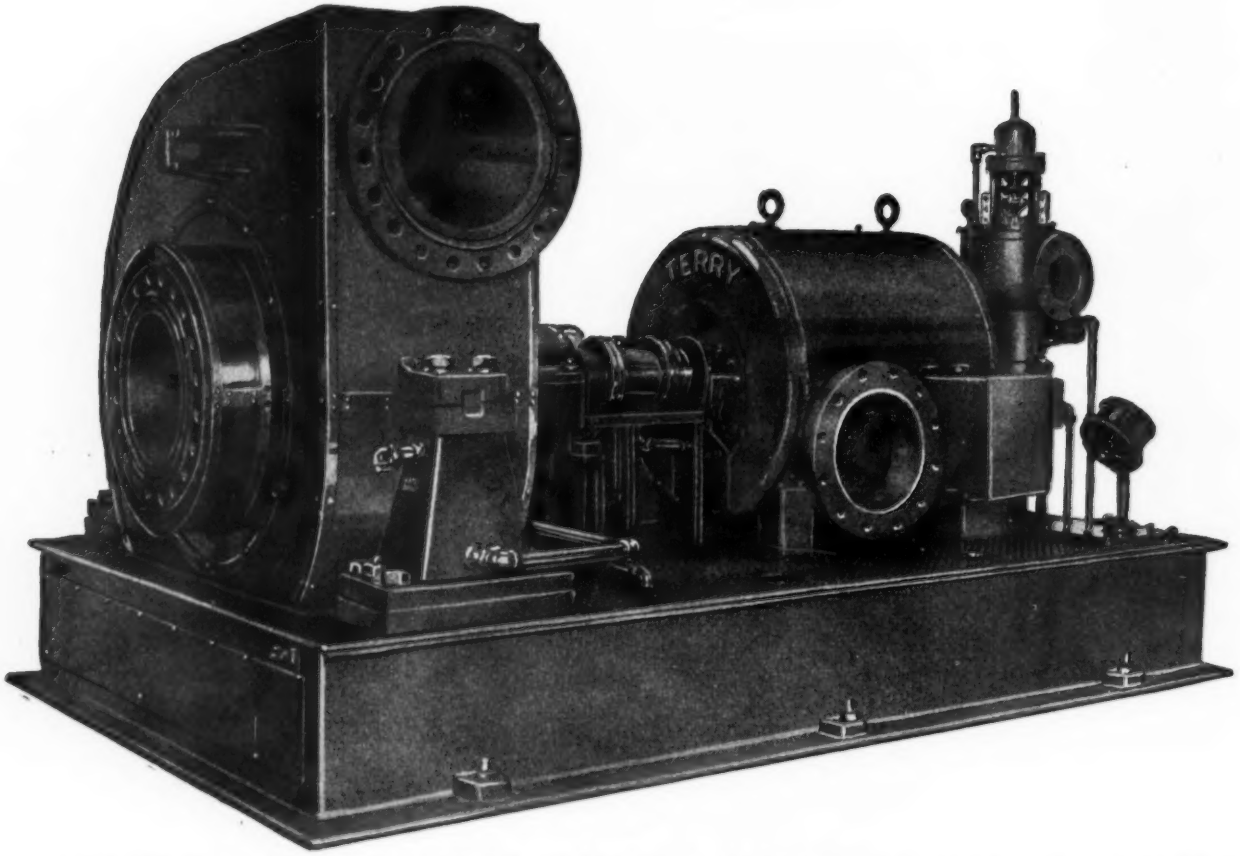
LEE RUBBER & TIRE CORPORATION

YOUNGSTOWN 1, OHIO

REPUBLIC INDUSTRIAL PRODUCTS
YOUNGSTOWN, O.

LEE DELUXE TIRES AND TUBES
CONSHOHOCKEN, PA.

# *The* TERRY TURBINE




## MULTI-STAGED TURBINES CAREFULLY ENGINEERED TO MEET YOUR REQUIREMENTS

Each Terry Multi-staged Turbine is individually designed and proportioned in accordance with the plant conditions and requirements.

A typical unit is shown above direct connected to a blower. This turbine is rated 1200 H.P. at 6100 R.P.M. It is equipped with six stages and operates condensing. The governor is of the oil relay variable speed type. The lubrication system provides flood lubrication to the turbine and blower bearings.

If you have an application for a turbine — single staged or multi-staged — geared or direct connected — standard or special — in sizes up to 2000 H.P. — talk it over with Terry.

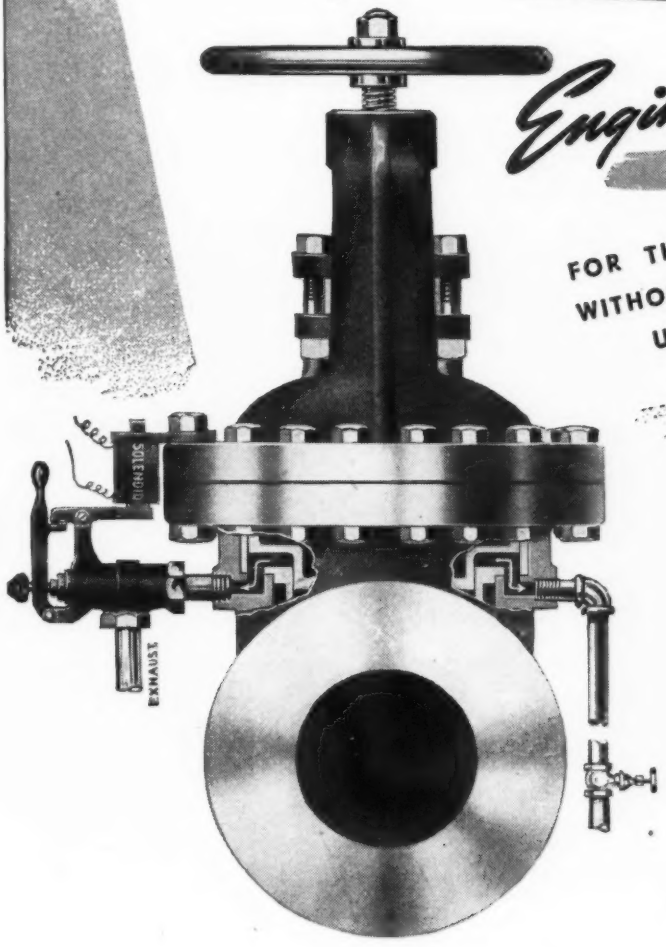
T 1162

**THE TERRY STEAM TURBINE COMPANY**
**TERRY SQUARE, HARTFORD, CONN.**

INSTANT! AUTOMATIC! UNFAILING!

*Engineered Protection*

FOR THE MOST EXACTING INSTALLATION
WITHOUT BANGING, CHATTER OR SPINNING
UNDER ANY FLOW CONDITIONS




**GOLDEN-ANDERSON**

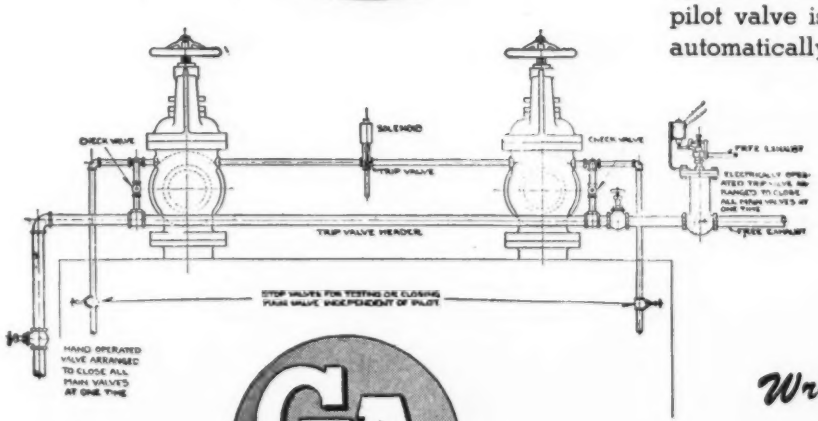
**Electric**

**EMERGENCY TRIP**

# VALVES

With the AC or DC Solenoid Trip Pilot Valve reset in its closed position, the valve will automatically open as the handwheel stem is run up. When the trip pilot valve is opened, the main valve will instantly, automatically close and remain closed until the trip pilot valve is manually reset. Main valve may be closed at any time with the handwheel.

Write for descriptive technical catalog listing more than 1500 sizes and types of engineered Golden-Anderson Valves.


CHECK VALVE
SOLENOID
TRIP VALVE
CHECK VALVE
TRIP VALVE HEADER
STOP VALVES FOR TESTING OR CLOSING MAIN VALVE INDEPENDENT OF PILOT
HAND OPERATED VALVE ARRANGED TO CLOSE ALL MAIN VALVES AT ONE TIME

**Arrangement of Valves with individual solenoid pilot control, as well as for simultaneous closing by master solenoid pilot valve with valve header unit.**

*Write for descriptive technical catalog!*

GA

GOLDEN-ANDERSON

VALVE Specialty Company

FULTON BUILDING • PITTSBURGH 22, PA.

"Way back when," it was the watchmaker's eyepiece; today its the "Comparitor," shown above, which magnifies rack and pinion teeth fifty times. Faults can truly be seen . . . and corrected by machines that can't go wrong.

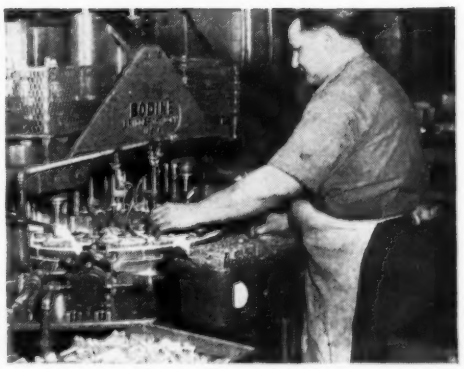
# *Craftsmanship* . . . then and now

LONG AGO that fabled and revered craftsman, the "instrument maker," sought precision in pressure gauges and the like with the skill of his own Stradivarian hands. But although his praise has been sung across the years, his precision was only remarkable in relation to his methods.

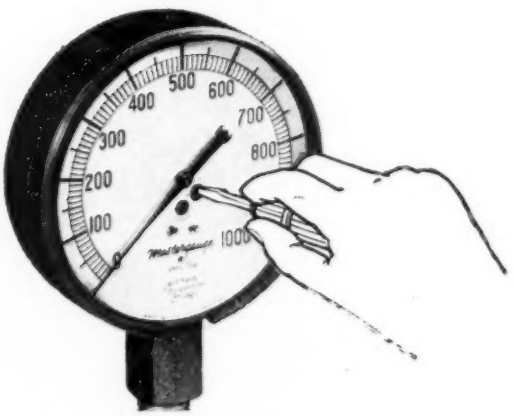
Today, greater precision — more lasting precision — is achieved on a production basis. This involves not only skill, but skill applied through highly specialized machines and highly organized methods.

The steps illustrated here are typical of many ways in which precision is attained in Marsh Gauges and Dial Thermometers. No Stradivari touch could achieve the precision found in the gears, pinions, staffs and bearings of Marsh Gauges that is attained by the special machines, jigs, fixtures, and production line testing that is employed in making them today!

Examine a Marsh Gauge. Observe its performance. You will then know the meaning of precision that can only be called Marsh!



"Way back when," it was slow hand drilling and filing and fitting; today machines like this perform many operations on the sockets, simultaneously and with unerring accuracy. Result: Greater precision at no greater cost.




**Only Marsh has the "Recalibrator"**—quickest and best way to correct a pressure gauge that has been knocked out of adjustment . . . finishing touch to a finer gauge.

JAS. P. MARSH CORPORATION
2075 Southport Avenue, Chicago 14, Illinois
*Export Dept.: 155 E. 44th St., New York 17, N. Y.*

**MARSH GAUGES**
"THE STANDARD OF ACCURACY"

# "KEEP IT CLEAN, BOYS,

## —and stay away from trouble . . ."

A little dirt can start a lot of grief—especially to valves, pumps, traps, meters, regulators, etc. Efficient strainers installed in the inlet side of such equipment is economical protection against unnecessary wear and possible shut-downs. Kieley & Mueller make dependable strainers for every steam, gas, water, oil, air and chemical application—bodies of iron, bronze or steel, with oversize baskets of bronze, monel, stainless steel or special alloys. And always of-course, the engineered superiority assured by K & M's 67-year experience—which, in strainers, means maximum filtration with minimum pressure drop. Write for catalog 66-C.

**KIELEY & MUELLER, INC.**
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879
NORTH BERGEN, NEW JERSEY

# HIGH TONNAGE CRUSHING
## *—with minimum headroom*
## *—and no refuse problem*

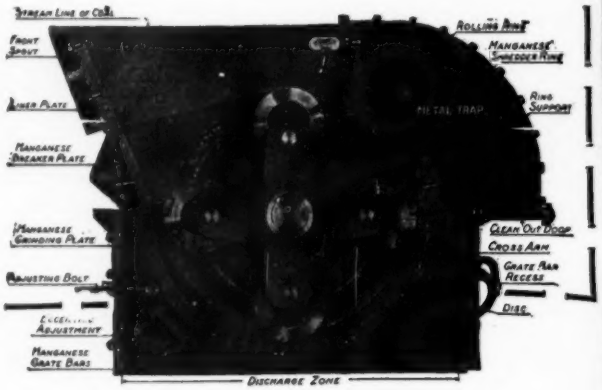
American Rolling Ring Crushers supply a complete coal reduction operation — No auxiliary crushing operations are necessary — properly sized screenings are produced for the stoker or pulverizer bunkers. There are no refuse disposal problems or disrupting shut-downs for clean outs.

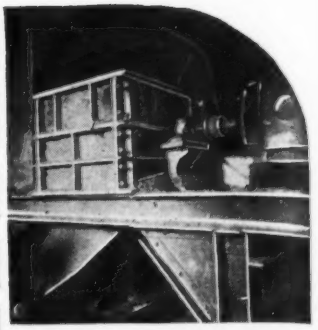
American's compact construction makes it a simplified installation that readily fits into ordinary coal preparation facilities.

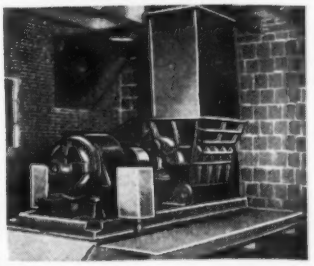
The uniform product of Americans, in a once-through operation, assures properly sized coal for efficient combustion for all types of firing.

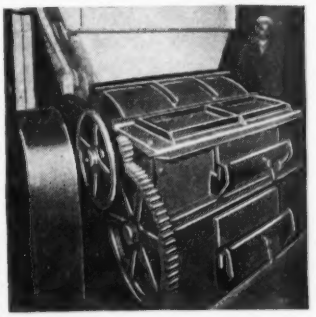
**Only American Rolling Ring Crushers have the shredder rings (shown here) which split coal instead of crushing it, for uniform sizing.**

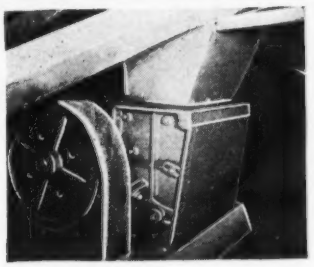
**Note compactness of design.**

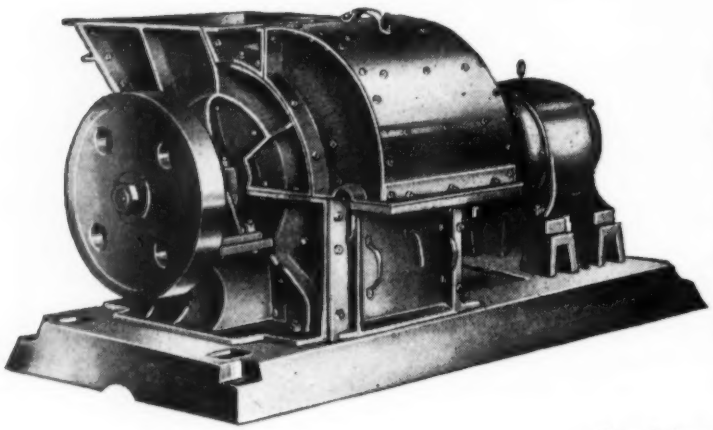


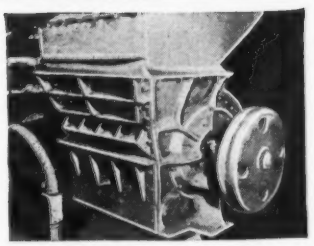









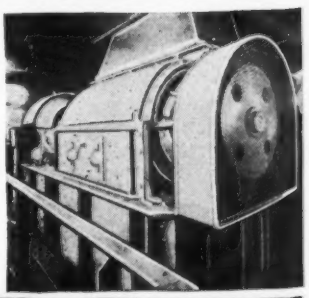




**The American "S" Model (at left) is reducing coal crushing costs in many power plants throughout the country to *less than 1¢* per ton.**

**American Rolling Ring Crushers are available in types and sizes to meet your coal preparation operation and your field conditions.**

**Capacities up to 500TPH.**



*Send for bulletin*
**"Crushing Coal At Less Than 1c. Per Ton."**

**American PULVERIZER COMPANY**

*Originators and Manufacturers of Ring Crushers and Pulverizers*

**1349 MACKLIND AVE.**
**ST. LOUIS 10, MO.**

# •Easy to install

## •SIMPLE AND COMPACT

# •HUSKY!

It's obvious that the close-coupled pump is easy to install! It's equally clear that it's simple and compact. And—if you look at the picture, you'll see what we mean by, "Husky".

Buffalo Close-Coupled Pumps are built to stay on-the-job. Plenty of metal all over. Large stuffing box. Heavy-duty impeller.

The result? Pumps that give years of first-class service. Write for Bulletin 975-B which gives complete details and ratings.

**BUFFALO PUMPS, INC.**

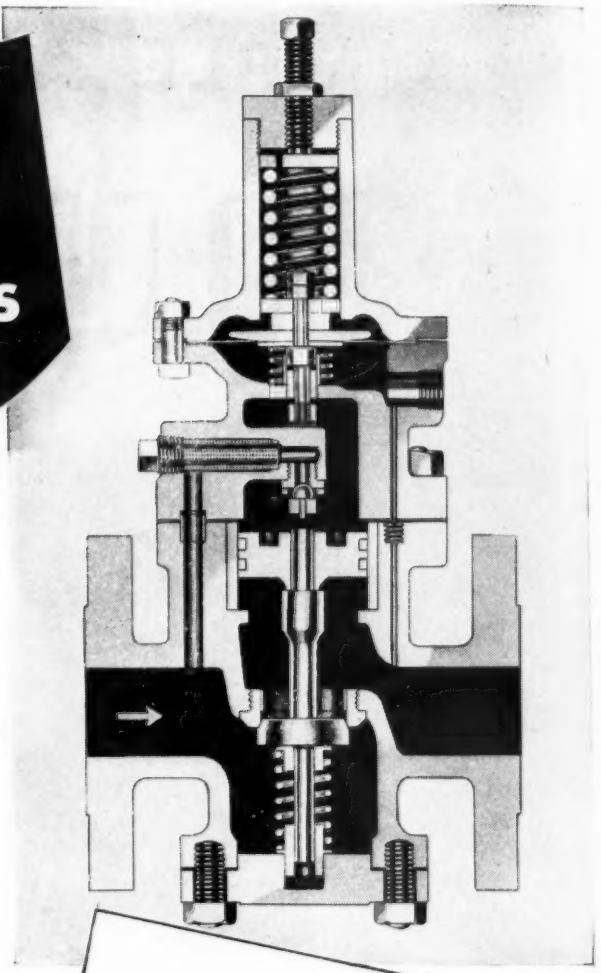
488 BROADWAY BUFFALO, N. Y.

*Canada Pumps Ltd., Kitchener, Ont.*

"Buffalo" Close-Coupled **PUMPS**

# *Accurate Pressure Control* with

GENUINE
**STRONG**
*IMPROVED*
**Regulating Valves**
STEAM • AIR • GAS



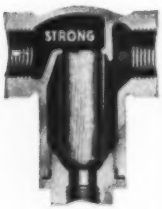
**For Sensitive Pressure Regulation, Use This Single-Seated, Pilot-Controlled Valve!**

***Recommended especially for:***

- **Processes with intermittent or fluctuating demand;**
- **Processes requiring extremely sensitive control;**
- **Applications where dependability is essential.**

STRONG Type C Valve, illustrated at right, available in semisteel or cast steel, for pressures to 400 psi (600° F.). With ANUM-METL* seats and discs, optional internal or external pilot control, this valve automatically adjusts itself to maintain accurate reduced pressure.

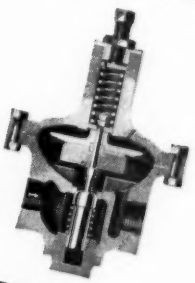
Completeness of the STRONG line—steam traps, vacuum traps, pressure regulating valves, strainers, separators, continuous blowdown valves and other steam specialties—enables us to recommend exactly the right type and size for your particular application. Write us about your problem and ask for the new STRONG Regulating Valve Catalog No. 155.




**STRONG "Quick-Cleaning" Strainers**

STRONG improved strainers, of semisteel or cast steel construction, protect reducing valves, steam traps, control equipment, etc., by taking out scale, dirt and sediment. Available in "T" or "Y" types.

**STRONG, CARLISLE & HAMMOND COMPANY**
**Cleveland 13, Ohio**



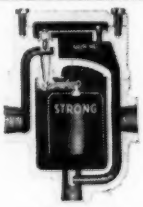
TYPE K REDUCING VALVES are direct operated, single seated and of extra heavy semisteel construction suitable for pressures to 225 psi (400° F.). Features ANUM-METL seat and disc and internal strainer. For steam, air, water or gas.

*Trade Mark Registered.

REG. TRADE MARK

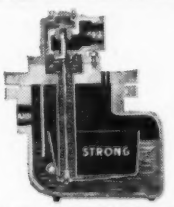
OTHER **STRONG** STEAM SPECIALTIES

ANUM-METL Reg. Trade Mark



Blast Trap

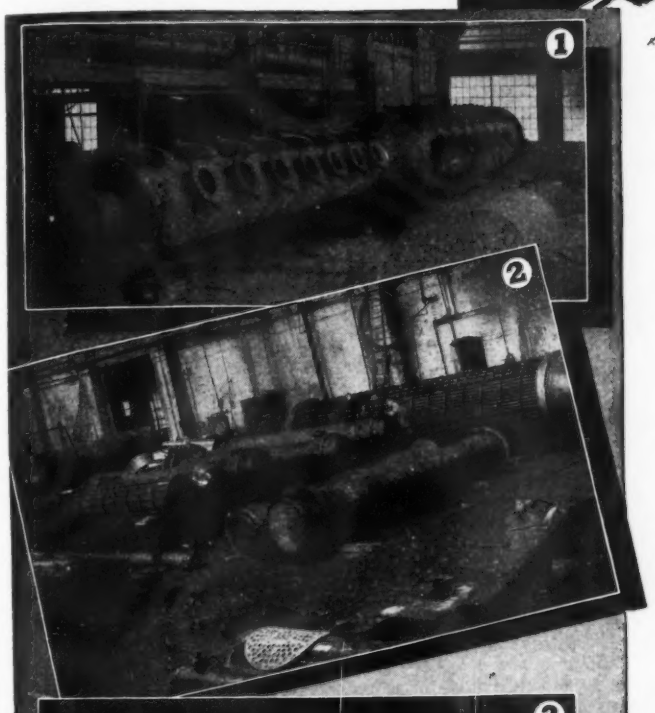
No. 80 Series Trap

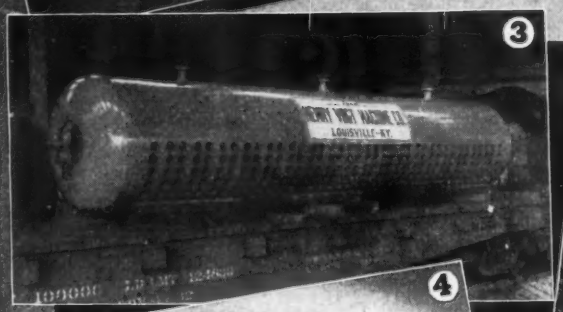


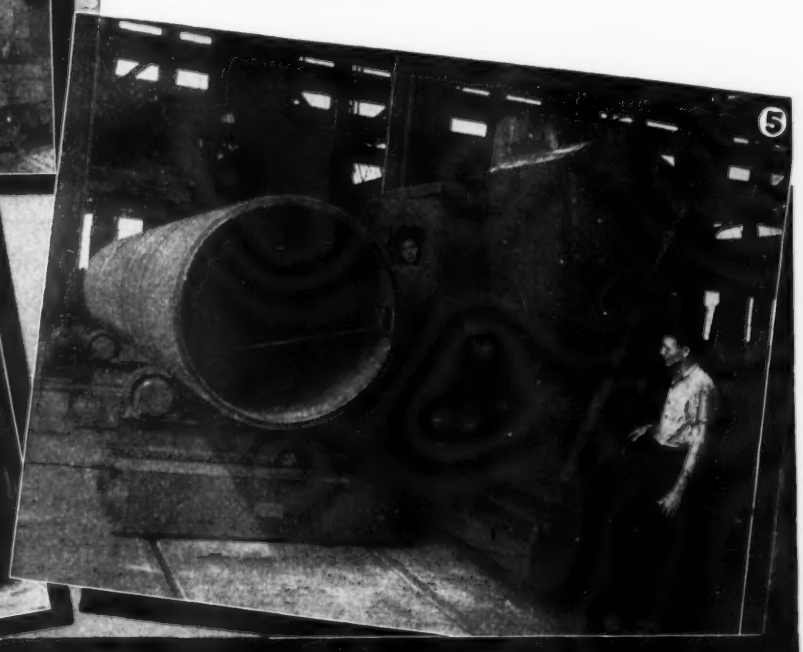
Large Capacity Trap

A.P.I.—A.S.M.E. and A.S.M.E. CODES • CARBON STEEL AND SPECIAL STEE

# WELDED PRODUCTS by Vogt






**1 -** 4′—0″ dia. x 7′—6″ dia. x 82′—5″ high Stabilizer Tower for a Texas Refinery. Fabricated to A.P.I.-A.S.M.E. Code, stress relieved and X-rayed. 250# working pressure.

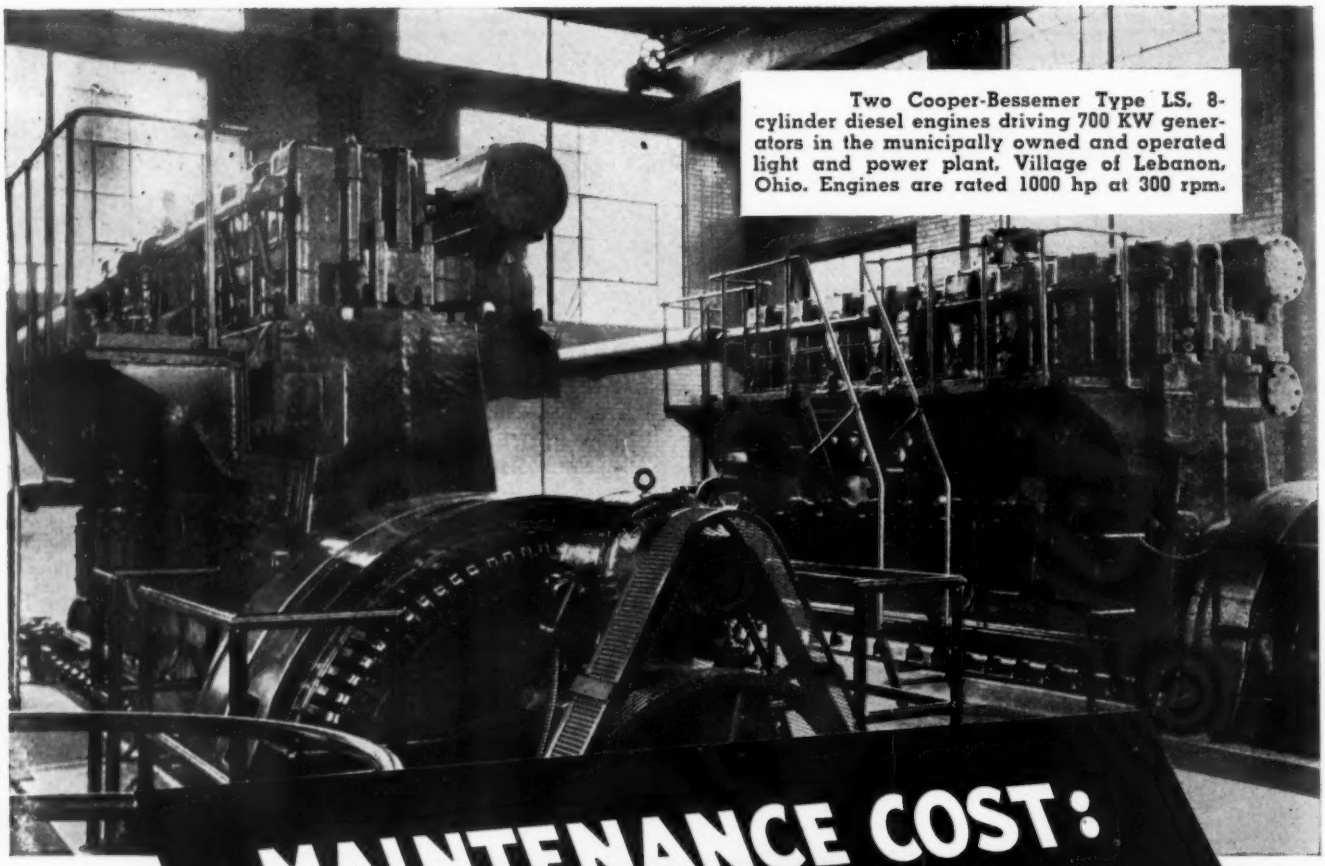
**2 -** Heat Exchangers, for an Eastern Refinery, on the testing floor. Units have fusion welded Monel Metal shells and were built to customer's specifications.

**3 -** 48″ dia. x 22′—6″ long mud drum for a Vogt Water Tube Boiler designed to operate at 450# S.W.P. Fusion welded to A.S.M.E. Boiler Code.

**4 -** Battery of Absorption Columns in a Western Refinery. Units are 33″ dia. x 41′—0″ high and were stress relieved after welding.

**5 -** 400 KV Industrial X-ray unit in our plate welding department. Exographs of welded seams can be quickly made because of the special motor operated rolls and traveling carriages which are adjustable to vessels of any size.

**HENRY VOGT MACHINE CO.**
Incorporated
LOUISVILLE, KENTUCKY
BRANCH OFFICES: NEW YORK · PHILADELPHIA · CLEVELAND · CHICAGO · DALLAS



Two Cooper-Bessemer Type LS, 8-cylinder diesel engines driving 700 KW generators in the municipally owned and operated light and power plant, Village of Lebanon, Ohio. Engines are rated 1000 hp at 300 rpm.

# MAINTENANCE COST: less than 1% per year

THESE two Cooper-Bessemer diesels powering the Lebanon, Ohio, municipal power and light plant have been in continual service since November, 1941. Maintenance cost is averaging less than 1 percent of engine cost per year. Here is a typical example of the maintenance economy demonstrated time and again in Cooper-Bessemer installations.

How about operating economy and efficiency? Mr. L. F. Wertz, Lebanon's capable plant superintendent, says, "Our fuel bill runs less than ½ cent per KW generated. Last month lube oil consumption cost us only .015 cents per KW. Bonds issued to finance our new plant are being retired much faster than originally estimated due to the earnings made possible by the efficiency of our Cooper-Bessemer Diesels." Mr. Wertz might also tell you that power is delivered at a highly competitive rate and that village-consumed power, valued at $12,000 per year, is furnished free.

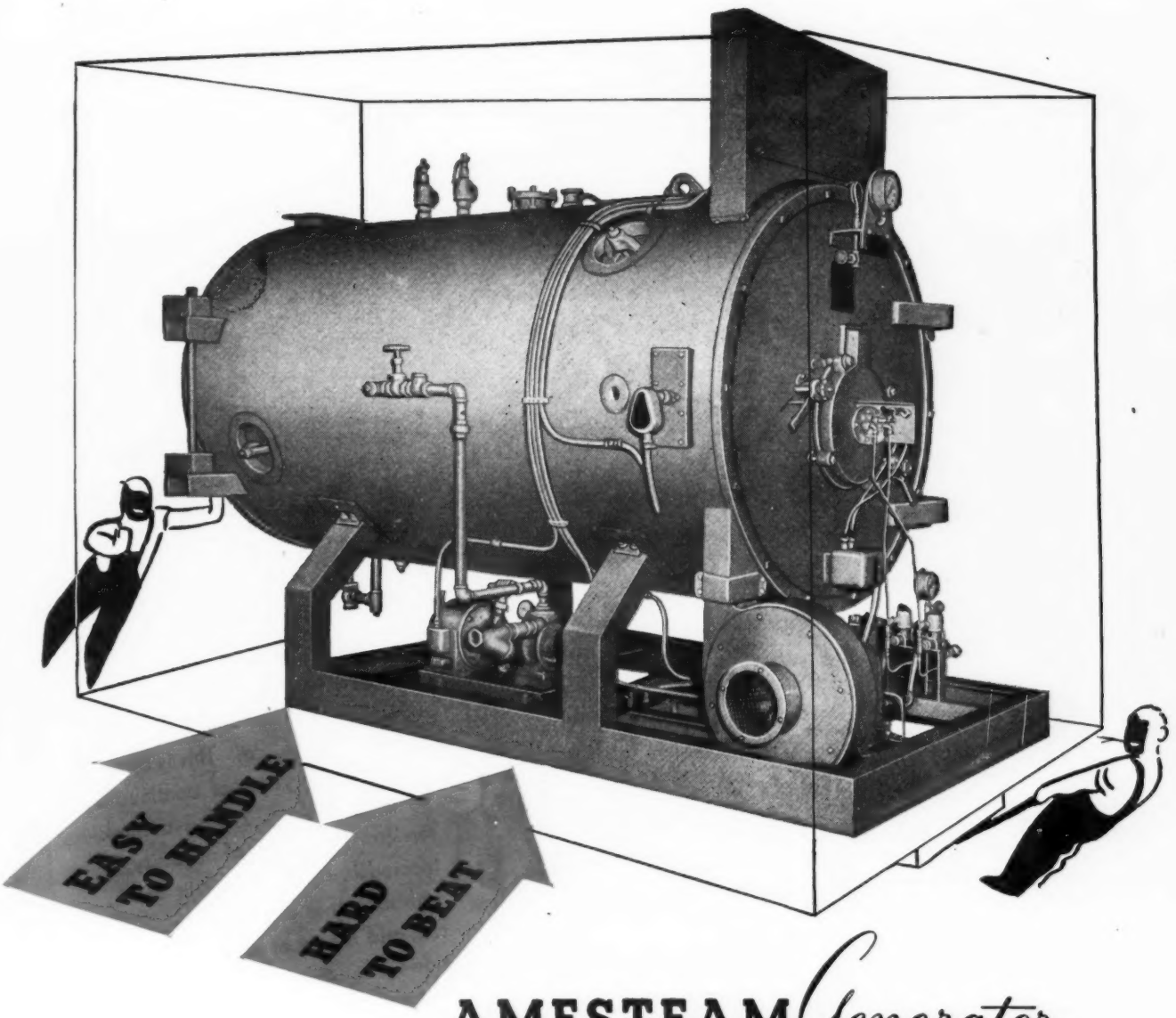
Modern, long-lived Cooper-Bessemer diesels are available in sizes and types for virtually all heavy-duty requirements, stationary or mobile. Contact the nearest Cooper-Bessemer office for complete details.

THE Cooper-Bessemer CORPORATION

Mt. Vernon, Ohio • Grove City, Pa.

New York, Washington, Gloucester, Dallas, Houston, St. Louis, Los Angeles, Seattle, San Francisco, and the Calmes Engineering Company, New Orleans, La.

BUILDERS OF DEPENDABLE ENGINES FOR 112 YEARS




# AMESTEAM *Generator*

AMESTEAM Generator provides power on an easy-to-handle, hard-to-beat basis, for the small and medium-sized plant.

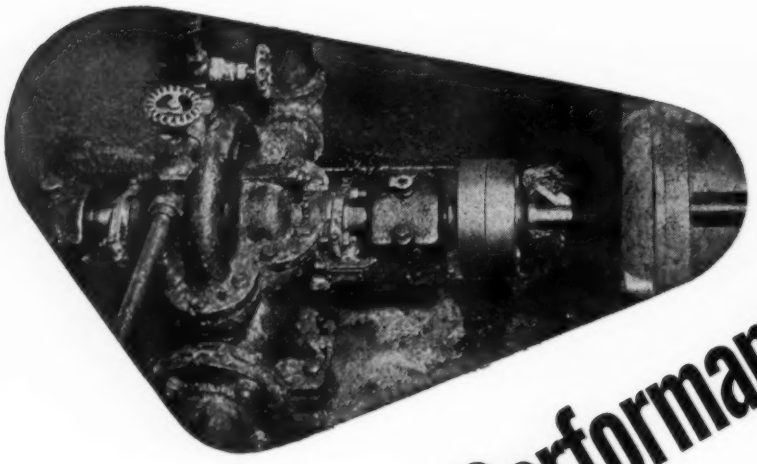
It's a complete, compact unit of power, automatic in operation. You simply connect water, fuel, electricity and steam . . . push the button . . . and let it go to work for you. And because it's so easy to get at, any repairs, when necessary, can be completed in minimum time.

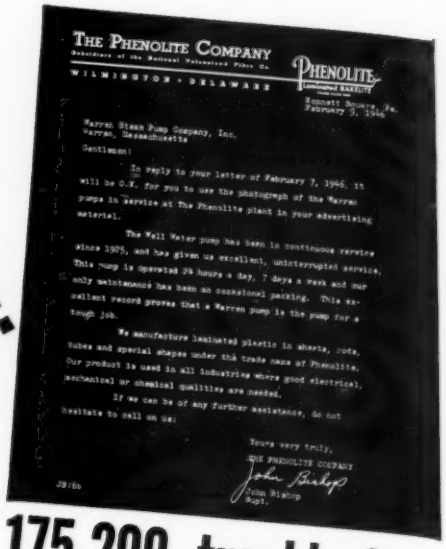
This means that you get year after year operation without complications. You get all the power you need, in the easiest way possible. All because the AMESTEAM Generator has 100 years of Ames' experience behind it. Write today for full information. AMESTEAM Generators come in units from 10 to 300 horsepower.

*A complete Return to the Boiler System, including Feed Water Pump and Condensate Tank with their accessories, is part of the standard equipment with every standard AMESTEAM Generator.*

**AMES IRON WORKS**

BOX 85 OSWEGO, NEW YORK





THE PHENOLITE COMPANY
Subsidiary of the National Vulcanized Fibre Co.
WILMINGTON • DELAWARE

PHENOLITE
Laminated Plastics

Kennett Square, Pa.
February 9, 1946

Warren Steam Pump Company, Inc.
Warren, Massachusetts

Gentlemen:

In reply to your letter of February 7, 1946, it will be O.K. for you to use the photograph of the Warren pumps in service at The Phenolite plant in your advertising material.

The Well Water pump has been in continuous service since 1925, and has given us excellent, uninterrupted service. This pump is operated 24 hours a day, 7 days a week and our only maintenance has been an occasional packing. This excellent record proves that a Warren pump is the pump for a tough job.

We manufacture laminated plastic in sheets, rods, tubes and special shapes under the trade name of Phenolite. Our product is used in all industries where good electrical, mechanical or chemical qualities are needed.

If we can be of any further assistance, do not hesitate to call on us.

Yours very truly,
THE PHENOLITE COMPANY
John Bishop
Supt.

JB:Bb

# Can you top this Performance?

## 175,200 trouble-free pumping hours

This is the record set up by a Warren Single Stage, Double Suction, Centrifugal Pump at the plant of The Phenolite Company, Kennett Square, Pa. This is based upon twenty years of continuous 24-hours-a-day, 7-days-a-week service. The pump, of necessity, is located in a pit 10 feet in depth, with six inches of water in the bottom and plenty of moisture on the side-walls. A tough job, requiring a tough pump . . . and yet over this long period the user says the only maintenance has been an occasional packing! Other Warren Pumps at Phenolite, and elsewhere, are performing equally well.

If your pumping problem involves General Water Service, Boiler Feed, Paper Mill Services, Process, Dewatering, Condensate Return, Oil Handling, Hydraulic Pressures . . . or other services, your inquiry will receive prompt attention.

**WARREN STEAM PUMP COMPANY, INC.**
**WARREN, MASS.**

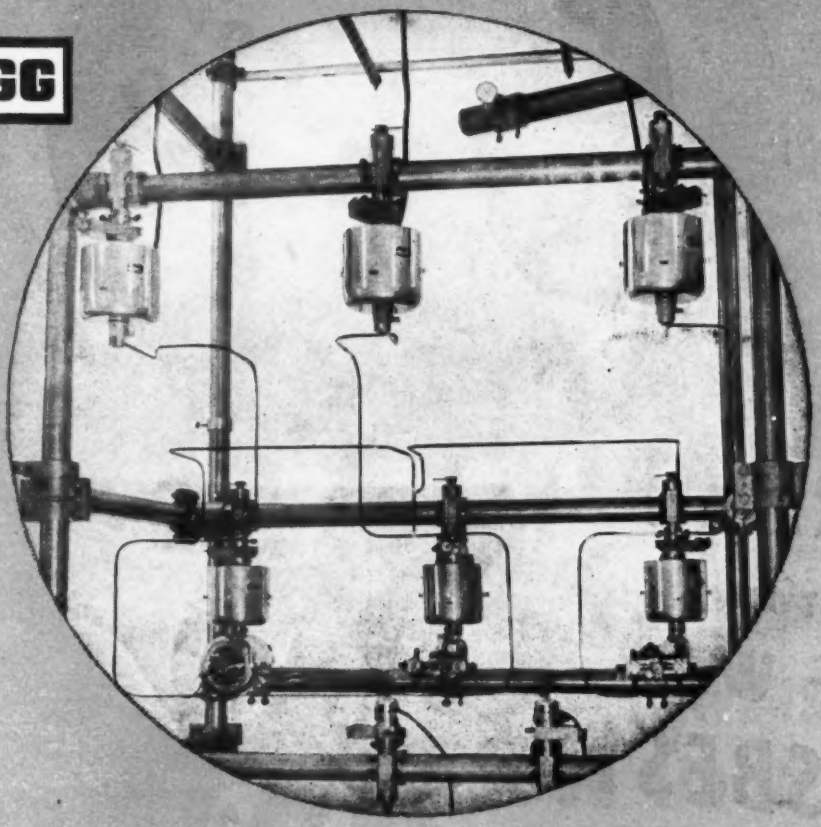
Atlanta Boston Chicago Cleveland Detroit Houston Hartford
Indianapolis Los Angeles Minneapolis New Orleans New York
Philadelphia Pittsburgh Richmond San Francisco Seattle

*For greater dependability, longer life, lower maintenance*

# WARREN PUMPS

# KELLOGG MODEL TESTING APPARATUS

## set up for determining end reactions and stresses in 1250 psi, 900 F. steam line



**The scale model illustrated is of 12" 1250 psi, 900 F. main steam piping. This layout connects three 430,000 lb. per hour boilers to three 40,000 kw. turbines with interconnecting crossover piping and comprises nine points of fixation and three intermediate restraints.**

**The Kellogg model testing apparatus can supply accurate answers to problems, that if solved mathematically, would involve 73 simultaneous equations—covering up to 12 points of fixation and seven partial restraints.**

**This apparatus, using scale models and electrical strain gauges capable of measuring load deflections to one millionth of an inch, eliminates the possibility of error, reduces figuring time and enables Kellogg to furnish piping assemblies with complete assurance that they will perform as required.**

**This design research is available to consulting, power, process and marine engineers.**

**Write today for copy of the new bulletin "Analyzing Piping Stresses by Tests of Models". No obligation is involved.**

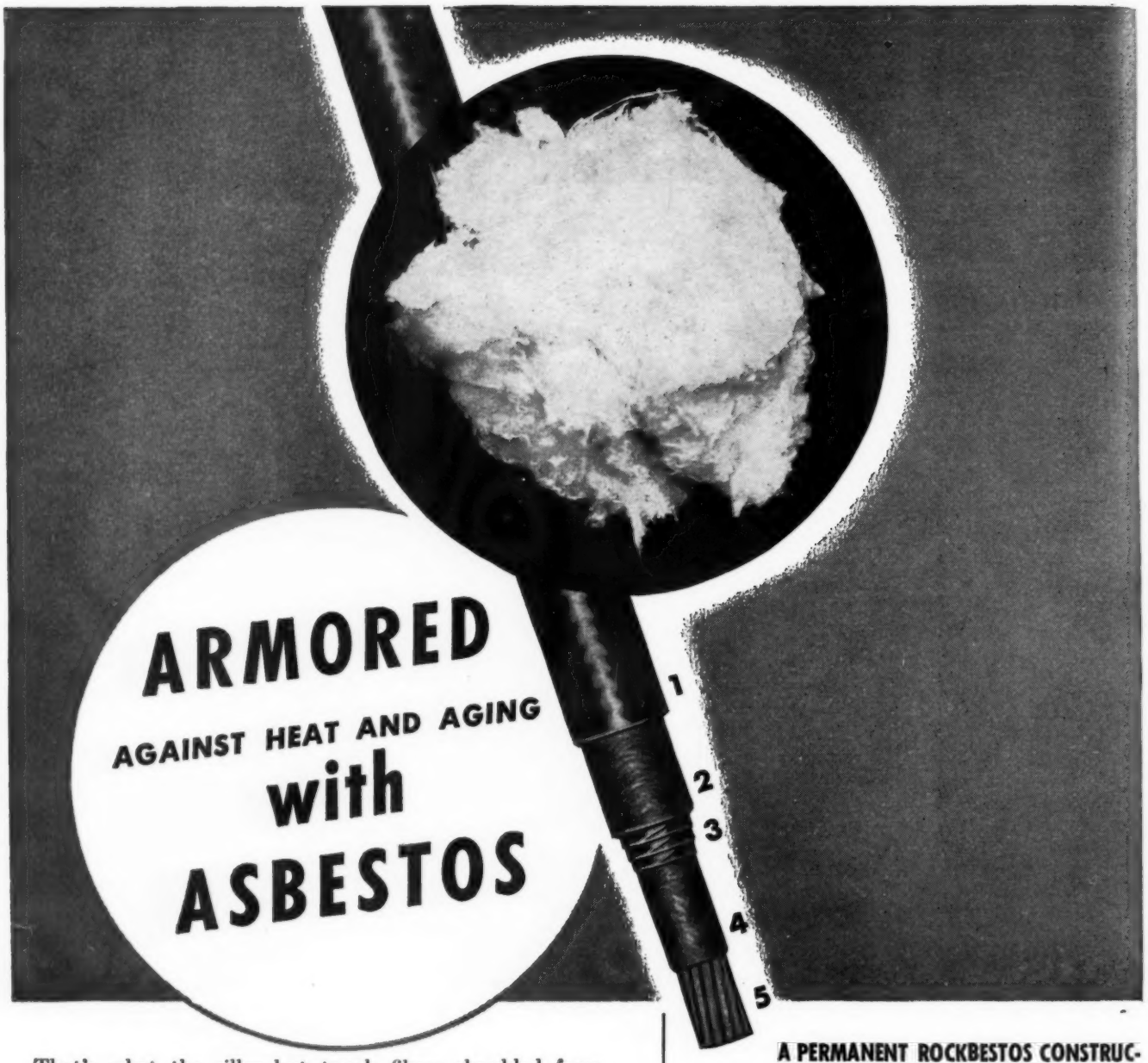
# KELLOGG

**"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.**

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, NEW YORK 7, N. Y.

REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND · HOUSTON 2, TEXAS: 402 ESPERSON BLDG. · TULSA: PHILTOWER BLDG.




That's what the silky but tough fibres shredded from heatproof, fireproof, age-resistant crude asbestos do for Rockbestos A.V.C. wires and cables. They actually *armor* them against baking heat, oxidation, rotting fumes, oil, grease, and even flame, with insulation that is *practically indestructible!*

This permanent *asbestos insulation* gives you wires and cables that guarantee dependable operation of power, control and lighting circuits in high ambient temperatures—near boilers, steam lines, furnaces, kilns, soaking pits or in hot tunnels—and assures trouble-free performance of equipment that must function without failure even though it operates under severe conditions.

For *permanent installations* that practically eliminate maintenance and replacement use Rockbestos A.V.C. and All-Asbestos wires and cables—in 300 to 5000 volt ratings—single or multi-conductor—plain, lead sheathed or armored. Write for a catalog.

**ROCKBESTOS PRODUCTS CORP. 135 NICOLL ST., NEW HAVEN 4, CONN.**

# ROCKBESTOS A.V.C.

## *The Wire with Permanent Insulation*

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS
LOS ANGELES SAN FRANCICSO SEATTLE PORTLAND, ORE.

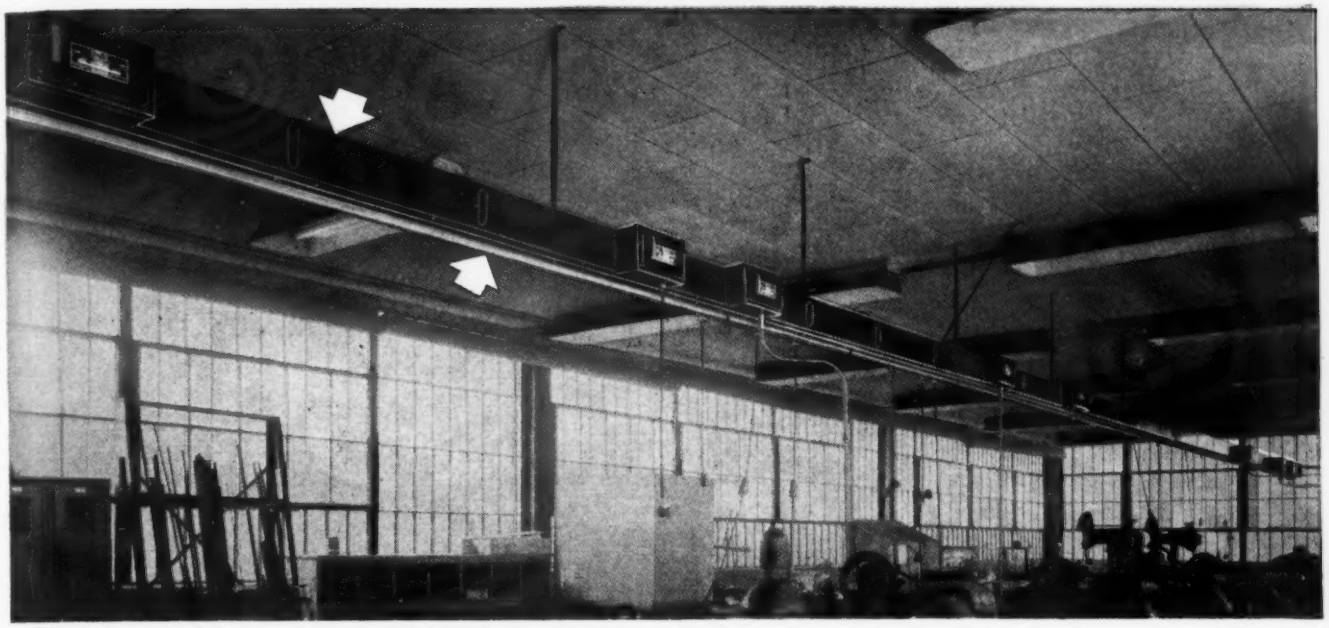
### A PERMANENT ROCKBESTOS CONSTRUCTION THAT ASSURES LONG-LIVED SERVICE

Rockbestos A.V.C. 600 Volt Power Cable above and similarly insulated Motor Lead Cable (Nat. Elec. Code Type AVA) have a maximum operating temperature of 110°C (230°F.) and this permanent insulation:

1. A tough impregnated asbestos yarn braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.
2. Heat, flame and moisture resistant impregnated felted asbestos insulation that won't dry out, crack, flow or rot.
3. Asbestos-protected varnished cambric for high dielectric strength and added moisture resistance.
4. Inner wall of impregnated felted asbestos withstands conductor-heating overloads and won't bake brittle or burn.
5. The conductor is perfectly and permanently centered in helically applied non-flowing insulation that provides greater current carrying capacity.

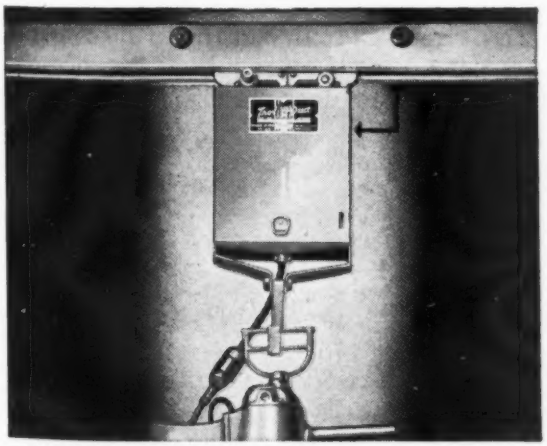
*One of 125 different constructions designed by Rockbestos for severe or unusual operating conditions.*

# VALUABLE *Time Saved!*



**BUSTRIBUTION DUCT** *gives you "Plug-in Power" for any machine set-up.*

**UNIVERSAL TROL-E-DUCT** *gives you "Flexible Lighting" which permits you to add and move lights without rewiring, or make radical changes in the lighting scheme any time.*



**INDUSTRIAL TROL-E-DUCT** *gives you "Moving Power" for Portable Tools, Cranes and Hoists—easily and quickly installed for ready mobile power.*

# 5114 PLANTS SPEED RECONVERSION WITH BULLDOG DUCT SYSTEMS

The ease and speed with which BullDog Electrical Distribution Systems can be rearranged or relocated — without material loss—is today saving countless hours and expense in the reconversion of thousands of U. S. industrial plants to peacetime production.

By making plug-in power immediately available for any machine set-up — by providing moving power for cranes, hoists and portable tools — by furnishing flexible lighting circuits, these modern Bus Duct systems will help keep production at top speed and efficiency.

If you would like to learn more about these completely flexible methods of power and light distribution, call a BullDog field engineer, or write for descriptive folders.

# BULLDOG

Detroit 32, Michigan. In Canada: BullDog Electric Products of Canada, Ltd., Toronto. Field Offices In All Principal Cities.

Also Manufacturers of Vacu-Break Safety Switches—SafTo-Fuse Panelboards — Switchboards — Circuit Master Breakers.

**BULLDOG ELECTRIC PRODUCTS CO.**

# TOUGH LAYOUTS

- ✔ Assured Safety
- ✔ Efficient Operation
- ✔ Minimum Fuel Costs
- ✔ Low Maintenance
- ✔ Long, Trouble-Free Life

## MADE SIMPLE BY NAVCO

The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your guarantee of an accurate and workmanlike Piping System.

***Consult Navco for your next Piping job***

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NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

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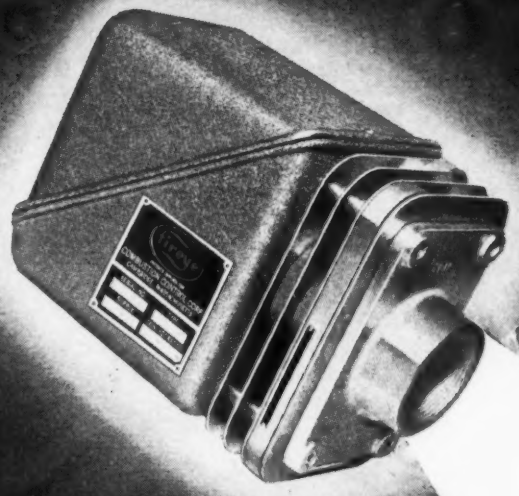


# Photoelectric FLAME-FAILURE Safeguard

fireye

## EXPLOSION PREVENTER

A flame failure safeguard must react instantaneously to provide full protection against the explosion hazard of flame failure.

Fireye is a photoelectric Flame Safeguard. It is actuated by the direct light of the flame itself. Fireye acts instantly on flame failure to cut off fuel and sound an alarm. Thousands of industrial and U. S. Navy installations throughout the world testify to the superiority of this equipment.

FACTORY MUTUAL FM APPROVED

ACTUALLY SEES FLAME

CONTINUOUS 24 HOUR PROTECTION

INSTANT FUEL CUT-OFF

MAINTENANCE FREE

EASILY INSTALLED

PROTECTED FROM RADIANT HEAT

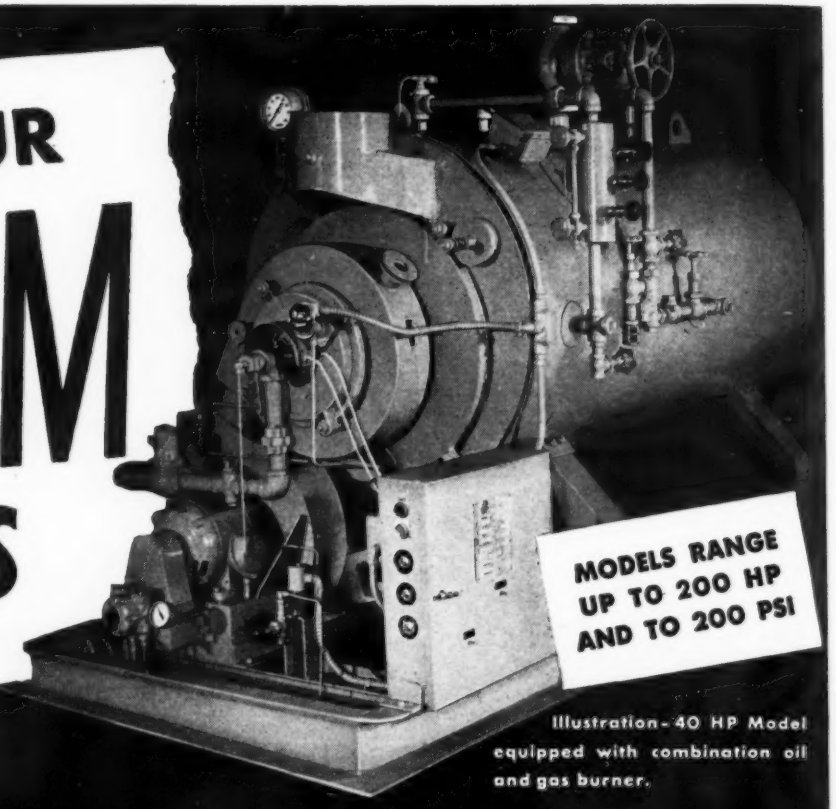
WRITE FOR YOUR BULLETIN 102-C TODAY.

ELECTRONIC FEEDWATER CONTROLS PHOTOELECTRIC FLAME MONITORS

COMBUSTION CONTROL CORPORATION

77 BROADWAY, CAMBRIDGE 42, MASSACHUSETTS

# CUT YOUR STEAM COSTS



MODELS RANGE UP TO 200 HP AND TO 200 PSI

Illustration—40 HP Model equipped with combination oil and gas burner.

## with a Cyclotherm Steam Generator

## Costs less to install, less to operate

The many Cyclotherm Steam Generators now in use are setting new, high standards for efficiency and economy in steam production. The engineering "know-how" gained by Cyclotherm engineers from their experience with thousands of industrial and war service installations is built into every unit. This knowledge is the best assurance of Cyclotherm's remarkable operating stamina and long-life service.

Cyclotherm's completely automatic operation and exclusive principle of combustion and heat transfer maintain better than 80% operating efficiency—hold fuel and operating costs to the minimum.

Cyclotherm units are arranged for either oil or gas firing. A special combination oil and gas burner permits the change-over from one fuel to the other by merely throwing a switch.

### Use of Heavy Oil and Wide Range Modulation

Cyclotherm units from 50 to 200 HP may be fired with heavy oil. These units may also be equipped with combination burners, firing either heavy oil or gas. Special automatic controls modulate the firing rate from 30% to 100% of fuel load in response to steam demands.

### Shipped as Complete Unit

Cyclotherm units are shipped complete with boiler, burner, all accessories and controls assembled; fully piped, wired; test fired and ready to operate on arrival. They are compact and space saving, and require no special base.

*Write, wire or phone for more complete information.*

## CYCLOTHERM STEAM GENERATORS

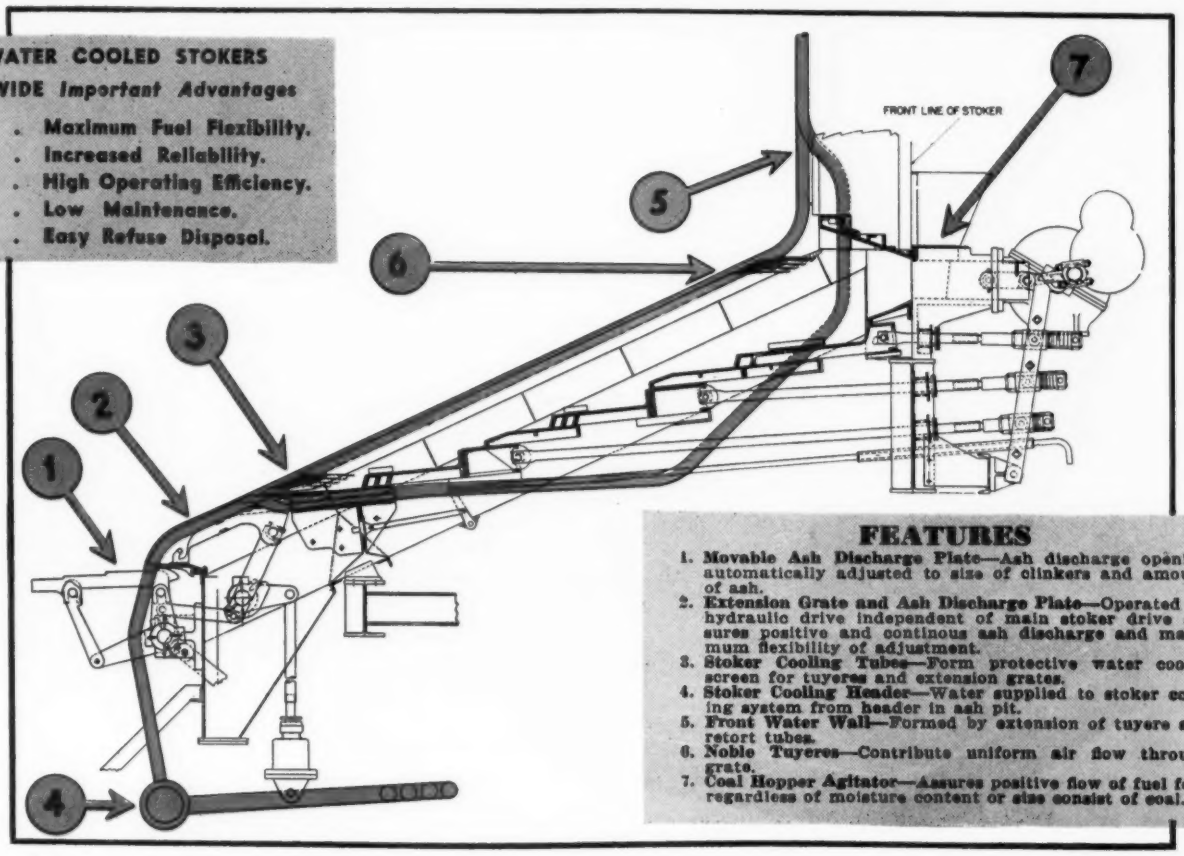
CYCLOTHERM CORPORATION, 90 BROAD STREET, BOX 702, NEW YORK 4, N. Y.

# FUEL FLEXIBILITY—DOLLAR EFFICIENCY

## . . . *featuring* WATER COOLED STOKERS

**WATER COOLED STOKERS**
**PROVIDE *Important Advantages***

- . . . **Maximum Fuel Flexibility.**
- . . . **Increased Reliability.**
- . . . **High Operating Efficiency.**
- . . . **Low Maintenance.**
- . . . **Easy Refuse Disposal.**




**FEATURES**

1. **Movable Ash Discharge Plate**—Ash discharge opening automatically adjusted to size of clinkers and amount of ash.
2. **Extension Grate and Ash Discharge Plate**—Operated by hydraulic drive independent of main stoker drive assures positive and continous ash discharge and maximum flexibility of adjustment.
3. **Stoker Cooling Tubes**—Form protective water cooled screen for tuyeres and extension grates.
4. **Stoker Cooling Header**—Water supplied to stoker cooling system from header in ash pit.
5. **Front Water Wall**—Formed by extension of tuyere and retort tubes.
6. **Noble Tuyeres**—Contribute uniform air flow through grate.
7. **Coal Hopper Agitator**—Assures positive flow of fuel feed regardless of moisture content or size consist of coal.

### NEW CONCEPT OF COMBUSTION EQUIPMENT DESIGN

Modern design practice, accepted by equipment manufacturers, consulting engineers and consumers, requires that new combustion equipment provide utilization flexibility that will permit the efficient use of the range of coals which are economically available in each market.

### WATER COOLING PROVIDES FLEXIBILITY

The illustration shows how one manufacturer of underfeed stokers has provided water cooling for the tuyere rows and furnace to obtain independence from variations in the ash softening temperature, volatile content and size consist of the coals which can be satisfactorily used.

### FUEL FLEXIBILITY — DOLLAR EFFICIENCY

The fuel specification for design purposes should include the critical characteristics of the range of coals which sound fuel planning forecasts as competitively available. The ability to select the best fuel value available at any time to obtain the lowest overall steam cost gives the highest dollar efficiency.

### FAIRMONT COAL

The Fuel Investigation reveals that in most markets Fairmont Coal will continue to be an excellent value in the foreseeable future. Many Utilities and Industrials are using the characteristics of Fairmont Coal in their Fuel Design Specifications in order to insure proper Fuel Flexibility and low-cost steam for their new plants.

## MAIL COUPON TODAY

**FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N. Y.**

Write for Reference Bulletin No. 5 for the details on investment required for flexibility in plants requiring 400,000#, 200,000#, or 60,000# of steam per hour. Your request will automatically put your name on our mailing list.

P546

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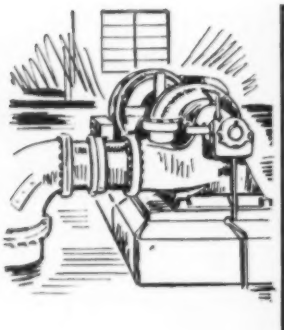
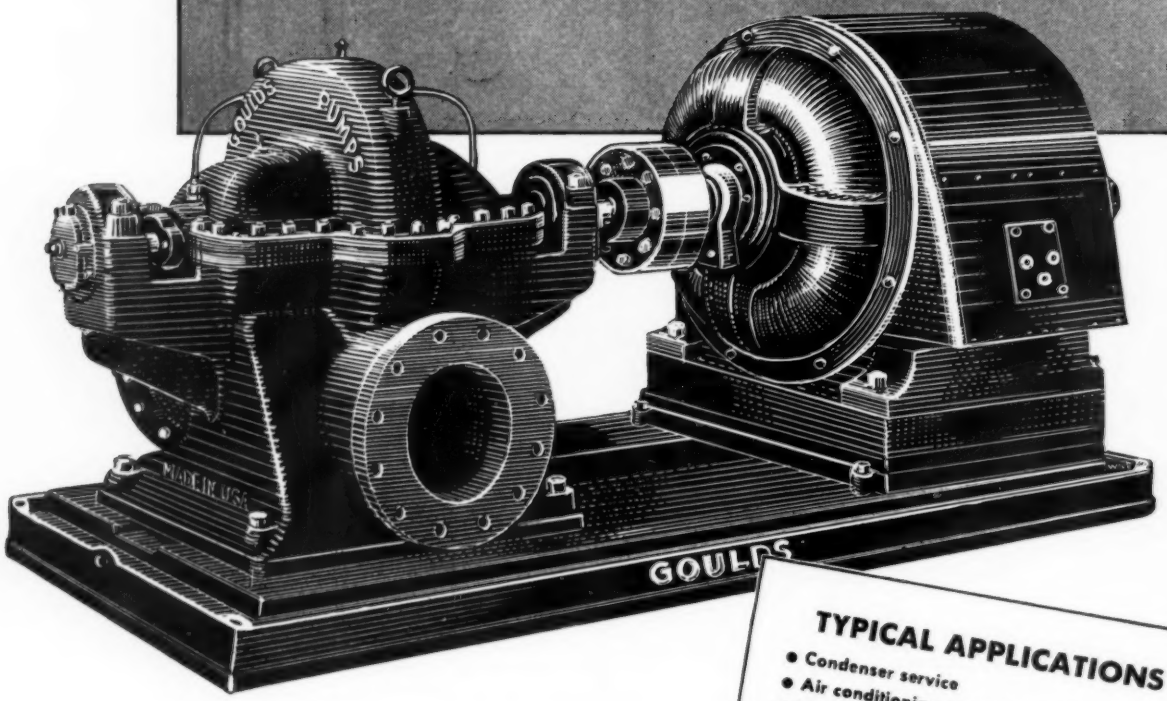
FAIRMONT COAL BUREAU
FAIRMONT REGION
WEST VIRGINIA
SERVICE TO INDUSTRY



# Goulds
## DOUBLE-SUCTION CENTRIFUGALS
## for dependable industrial pumping




Only a careful check would reveal the actual number of varied services for which Goulds *dependable* Double-Suction Centrifugal Pumps are being used in industries of all types. They have been shipped in large numbers since early 1900, have been constantly improved in design and operation. Today, *standard* units are economically pumping liquids ranging from water to crude oils!

Made in a wide range of sizes, they pump from 100 to 14,500 G.P.M. with heads up to 475 ft. depending on capacity. They are driven directly by electric motors, steam turbines, gasoline or Diesel engines, and through "V" or flat belt drives from any power source. Note some of the specific applications and features of these pumps shown at the right. This is the kind of pump performance you want! For further details, write Pump Headquarters or your nearest Goulds office.

### TYPICAL APPLICATIONS

- Condenser service
- Air conditioning and refrigeration
- Irrigation
- Municipal water supply
- Gasoline, oils and distillates
- White water in paper mills
- Process pumping
- General water service

### SPECIAL FEATURES

- Preformed micarta shaft rings prevent leakage—tested to 1000 P.S.I.
- Water quenched glands for high temperature liquids
- Replaceable tongue and groove wearing rings keep pump up to peak efficiency over the years
- Permanent bearing alignment—bearing housings cast integral with casing

# Goulds PUMPS, INC.

SENECA FALLS, N.Y.

**the PUMP FOR the JOB**

# Gilmer

## Endless Multiple V-Belts

**... assure peak performance and a longer belt life**

**Gilmer** special V-Belt design, plus extra sturdy construction and preconditioning, have resulted in the development of a V-Belt that transmits maximum power under heavy load, and stands up long in hard, continuous service.

Automatically locking in the grooves as they flex around the sheaves, Gilmer Multiple V-Belts exert a grip like a friction clutch. Yet they unlock freely and instantly when pressure is released. Being precision moulded, belt lengths are "cured" within small tolerances, and operate efficiently under correct tension without further matching.

Gilmer Multiple V-Belts are manufactured in all standard and many special sizes, for multiple and FHP drives, endless and non-endless, heavy or light duty, high or low speeds, long or short center drives. They are made on the largest assortment of V-moulds in the world.

Write for a FREE copy of the Gilmer Guide, the most complete V-Belt catalog ever published. It contains much valuable data that every power plant engineer should have.

**There are Gilmer Belts for every power transmission need**

**L. H. GILMER COMPANY** • Tacony, Philadelphia 35, Pa.
*Division of United States Rubber Company*

Gilmer BELTS

# CASH STANDARD
# AUTOMATIC COMBUSTION CONTROL SYSTEMS

CASH STANDARD instruments offer you an immediate and particularly short route to

**LESS FUEL COSTS • LARGER BOILER CAPACITY**
**SAVINGS IN MAINTENANCE**

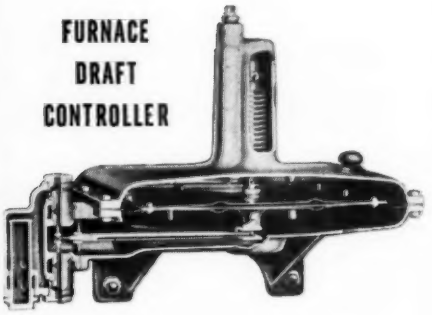
This is so because through this AUTOMATIC CONTROL you dependably and continuously regulate fuel feed — regulate the boiler uptake damper — and meter the air needed for combustion.

You can't help but get the very best results in boiler room performance through such control. You save every step of the way—you save in fuel required because there is no waste—you save in maintenance because of little attention required—you save through getting more steam from less fuel—your boiler becomes a bigger producer.

These CASH STANDARD units, available in a number of variation, can be combined to give you a cost-cutting Automatic Combustion Control System regardless of type of boiler or stoker or kind of fuel used.

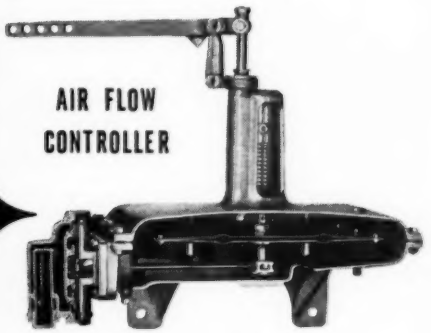
*Bulletin No. 300 GIVES YOU THE COMPLETE DETAILS Send for it.*

## FURNACE DRAFT CONTROLLER



This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from over-fire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

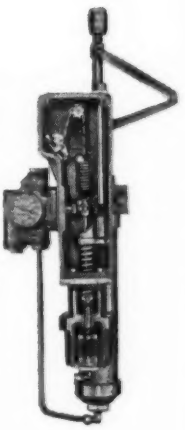
## AIR FLOW CONTROLLER



This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion —hence, money saving.

## FUEL FEED CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



**A. W. CASH COMPANY**
**DECATUR, ILLINOIS**

**CASH STANDARD CONTROLS . . VALVES**

Pre-fabrication brings to piping the benefits of factory methods and factory equipment. Pre-fabricated piping production is planned by men of long experience in the practical possibilities and limitations of piping. It is prepared in plants equipped with modern machinery and staffed by highly skilled organizations, including pressure welders whose work can be insured. This provides the exact control of procedure and the careful maintenance of quality that are characteristic of the best factory production.

Pre-fabricated piping is delivered to the job in a series of sub-assemblies ready to erect. All difficult operations have been performed . . . the sub-assemblies are commercially practical, correctly aligned, heat treated and stress relieved where necessary, thoroughly cleaned, shop tested and inspected. Piping pre-fabricated by a qualified fabricator is better piping . . . it saves money, time and trouble.

THE PIPE FABRICATION INSTITUTE

MEMBER P.F.I. THE PIPE FABRICATION INSTITUTE

*Devoted to the Technical and Economic Problems in Piping*

1108 CLARK BUILDING PITTSBURGH, PA.

G-9

# "... and what'll we do with the tickets?"

**THE PHONE STARTED RINGING** just as Harry Payne, Armstrong construction superintendent, was tying his necktie. Betty let him answer it. "Don't be long, Hon," she said, "or we'll be late for the show."

Harry recognized the voice of the Armstrong District Manager and said, "Hello, Bob." "Harry," Bob said, "Glad I caught you. Art Ward of Public Service phoned just after you left the office. They're finally ready for the heat insulation in their new power plant."

"Okay, Bob. I'll line up our crew tomorrow."

"Sorry," Bob cut in. "Afraid we'll have to get started tonight. Ward says he knows it isn't our fault that they've held us off all these weeks, but now we've got to finish it in 14 days. We can, can't we?"

"Guess so," Harry replied, casting a wry look at Betty. "Do we have enough material in the warehouse?"

"We have enough magnesia block and covering to get you started, and the factory promises to ship the rest of the material Tuesday."

"Well then, I'll start calling the men. Let's see. The crew on the Ajax job should be winding it up now. Those men are right here in town. And over at Marion, the Stutz job is held up because their pipe has been delayed. So that crew can be shifted for a while. . . ."

"Swell," Bob replied. "See you in the morning."

Harry hung up and turned apologetically to his wife. "Sorry, Betty. Looks like I'll have to be on the phone quite a while. . . ."

Betty sighed. "But why does everybody have to come to Armstrong with all the rush jobs? And what'll we do with the tickets?"

"Guess you'll have to treat Aunt Lily again," said Harry.

• • •

This little story is typical. And while we're not asking for tough insulation jobs, when a customer is in a tight spot and we can lend a hand, we're glad to do it. We're able to, in most cases, because our resources are a little broader and more flexible than most contractors can offer. Maybe that's why, as Betty says, customers seem to expect pretty remarkable service from Armstrong.

Armstrong's Contract Service is conveniently near you, in 27 major industrial cities from coast to coast. If you would like the complete facts, send for our new folder, "Armstrong's Insulation Contract Service." We think you'll find it interesting. Just drop a card to Armstrong Cork Company, Building Materials Division, 7005 Concord Street, Lancaster, Pennsylvania.

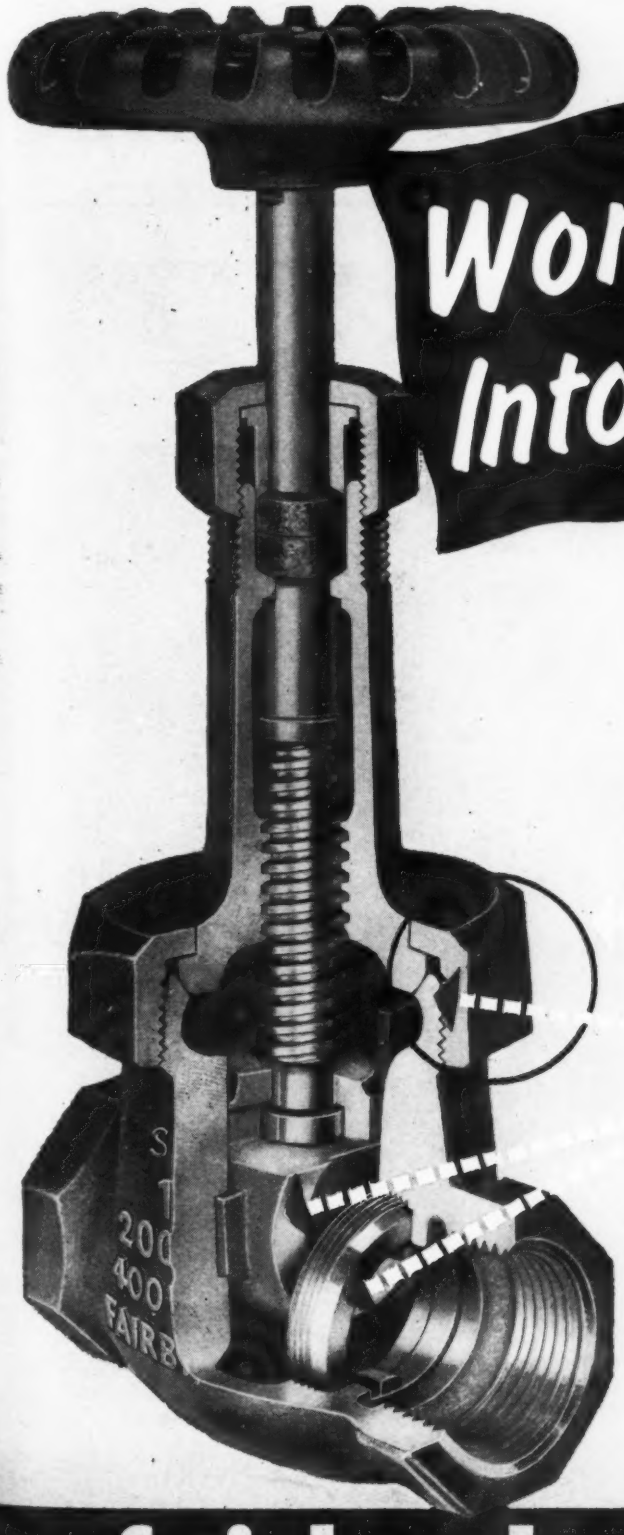
**ARMSTRONG'S INDUSTRIAL INSULATION**

*Complete Contract Service For All Temperatures*

From 300° Below Zero

To 2600° Fahrenheit

# American industry flows through fairbanks valves



## Worth Looking Into

...One Fairbanks Valve
...Three Fairbanks Features

***Union Bonnet Bronze Gate Valve for 200 lbs. Steam, 400 lbs. Water, Oil and Gas Pressure (Non-Shock)***

While no picture can do full justice to ruggedness of design and construction, the big cutaway view gives you at a glance the most important features of a widely applicable valve suited for severe operating conditions in processing and other work.

- **Union bonnet construction provides for easy dismantling and reassembly where frequent cleaning or inspection is necessary. Threads on outside of body are not subject to attack by fluids in line.**
- **Heavy octagonal bonnet nut holds radial body bonnet joint in pressure-tight alignment.**
- **Nickel alloy wedges and renewable seat rings provide extra long service through hardness and resistance to corrosion under pressure. Valve may also be had with integral bronze seats.**

This valve is furnished with rising or non-rising stem. Low in maintenance cost, this 200 lb. bronze gate valve is typical of the Fairbanks line of bronze, iron body, and all-iron valves. Write today for further information.

THE **fairbanks** COMPANY

393 LAFAYETTE STREET, NEW YORK 3, N. Y.

520 Atlantic Ave., Boston 10, Mass. 748 M & M Bldg., Houston 2, Texas 15 Ferry St., Pittsburgh 22, Pa.

**IT'S WORTH LOOKING INTO *BY EVERY INDUSTRIAL DISTRIBUTOR*** interested in a feature-crammed profit-building valve item "made to order for orders" . . . strongly backed by the long-established name of a well-known manufacturer.

# Home Town Enterprise

# on a Nation-wide scale

## OTIS MAINTENANCE FOR OTIS ELEVATORS

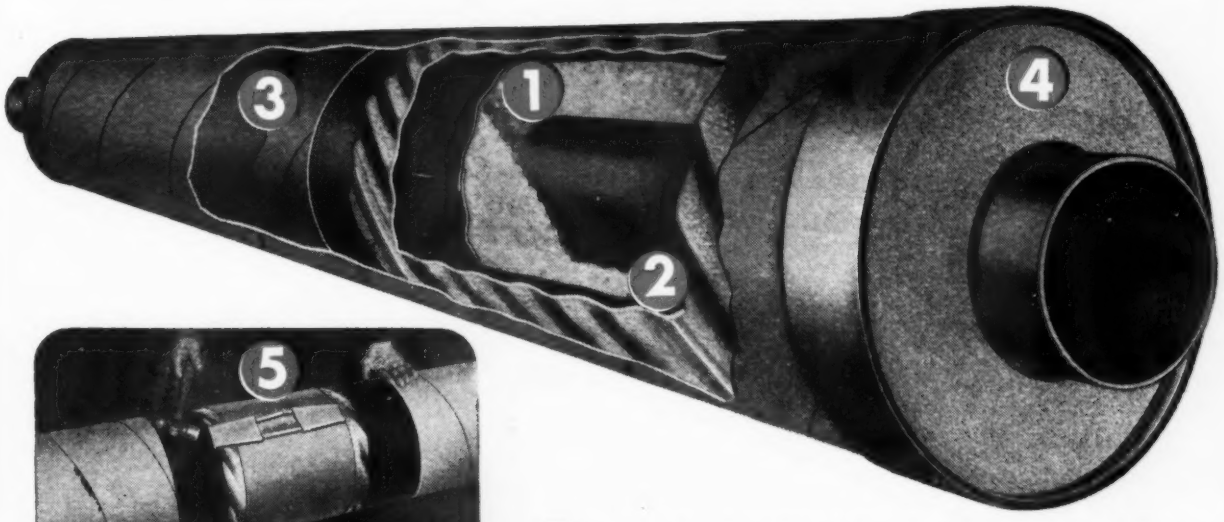
The men and women in your local Otis office — friends and neighbors of your townspeople — are working to maintain service on Otis elevators in your locality — at standards based on nation-wide experience.

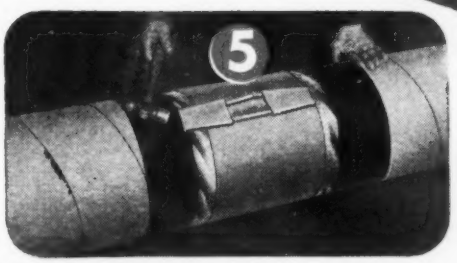
Your office and the 244 other Otis offices report regularly to headquarters on every elevator under Otis Maintenance Service, and standards for your locality are based on analyses of these nation-wide reports. If yours is a small freight elevator, it must compare favorably with 5,700 others in its class. If you have a high-speed gearless passenger installation, it is graded against more than 3,000 others in the same group.

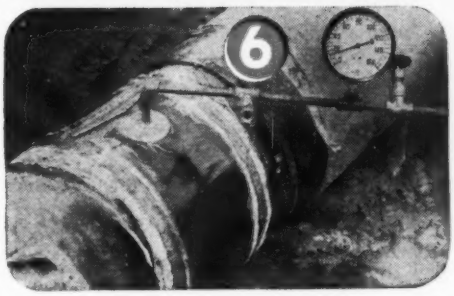
Otis Maintenance is a service by Otis for Otis elevator owners . . . available at a flat monthly rate through your local Otis office.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

# *Only* RIC-WIL STEAM CONDUIT *gives you ALL these advantages*




1. High-rating thermal insulation of required thickness applied to 21 ft. pipe—with sealed air space between insulation and housing.
2. Structurally strong, shock proof conduit housing seam-welded and hot-dip galvanized—permitting installation in shallow trenches.
3. Double coating of high melting-point asphalt, reinforced with felt wrapper—assuring long life and low maintenance.
4. Stuffing-box preseal rings on ends of conduit protect against water damage during construction—permitting installation regardless of weather or trench conditions.
5. Simplified connector speeds coupling of 21 ft. prefabricated sections in the field and facilitates making welded closures.
6. Full-welded conduit design and field-welded connections insure pressure-tight system. Air test may be applied before backfilling.

*When specifying conduit for underground (or overhead) steam distribution lines insist on Ric-wiL to obtain these features for the most efficient, maintenance free, permanent system.*

*All-welded construction* means a pressure-tight conduit capable of meeting air-pressure test. Conduit casing is 16-gage corrugated iron, seam-welded and hot-dip galvanized after welding. Simplified connector is readily welded to smooth conduit ends, held in place by drive clamps . . . *Ends of conduit are presealed* at the factory with a heavy pre-cast cylinder to protect insulation during storage on the job and installation—regardless of water conditions encountered . . . *Triple protection against the elements* is insured by Ric-wiL specifications for conduit covering. First, a thick coating of high melting-point asphalt is applied over casing. Second, asbestos felt is tension wrapped around conduit before asphalt is set. Third, another coating of asphalt is applied, which is finally protected by spirally wrapped heavy kraft shipping paper . . . *Installation is greatly simplified,* saving time and money on the job. Prefabricated 21 ft. sections, also prefabricated accessories—including expansion loops, elbow, tee-branch and anchor units, are furnished with ends fitted for easy coupling in the field. Because of the conduit's inherent strength, only 18″ of ground cover is required, even under trucking roads, minimizing excavation and back-fill. Pipes can be turned in conduit so that all pipe welding is done on top. Installation interferes little or none with other construction.

*If you have not yet used the full-welded Ric-wiL Prefabricated Insulated Pipe Units, specify them on your next job and be assured of the best. Descriptive Catalog on request.*

**RIC-WIL** INSULATED PIPE CONDUIT SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

# In Step with Industry

Paracoil Self-Cleaning Heat Exchanger. By moving the hand-wheel clockwise and counter clockwise the entire baffle-assembly is moved back and forth over the heating surface thus scraping any deposits from the tubes. Cleaning action is positive and effective. Ideal for heating fuel oil and other fouling liquids.

## Paracoil

### HEAT TRANSFER EQUIPMENT

Davis Engineering Corporation has played a major part in the development, design betterment and manufacture of distillation, evaporation and heat exchange equipment for more than 30 years.

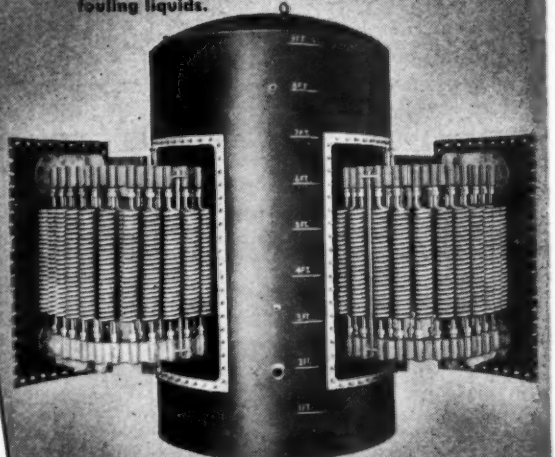
Pictured are Paracoil Heat Transfer units designed to serve America's industries as well in peace as they served the country during the war. Davis built heat exchangers assure greater production efficiency, reduced repair and cleaning costs and freedom from shutdown losses.

Paracoil equipment is available for practically every type of heat transfer application called for by our many and varied industries.

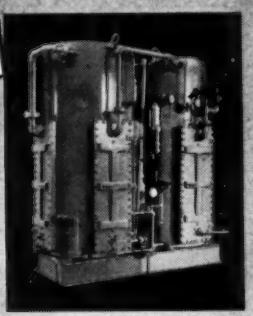
Technical and practical knowledge accumulated from 30 years of manufacturing experience and job performance, supplemented by continuous engineering research, have resulted in fundamental design improvements effecting advanced performance and increased resistance to severe service conditions.

Whether yours is a replacement, new, or more efficient equipment need, Paracoil Heat Exchangers are available on most reasonable delivery schedules and Davis engineers are ready to assist in making proper selection of size and design best suited for your particular problems.

*To those with fouling problems:* Write for bulletin HE-100 describing the Paracoil Self-Cleaning Tubular Heat Exchanger.

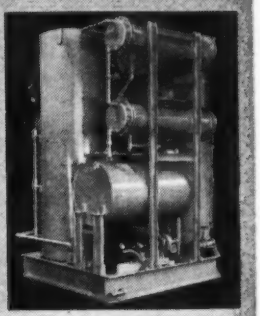


Paracoil Double-Door Evaporator. Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in single and multiple effects and in a wide range of capacities.



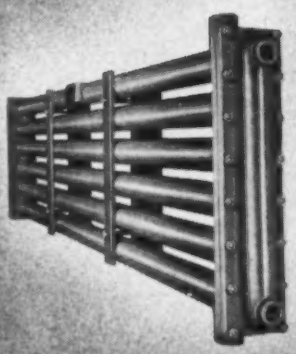
**FRONT VIEW**

Triple Effect Package Type Distillation plant built for supplying distilled water from sea water or contaminated water for drinking and process service. Illustrates Paracoil hinged door evaporators. A completely self contained unit.



**BACK VIEW**

This distillation unit has a capacity of 180 gallons per hour with low pressure steam and economical steam consumption. Other package types standardized for a number of capacities.



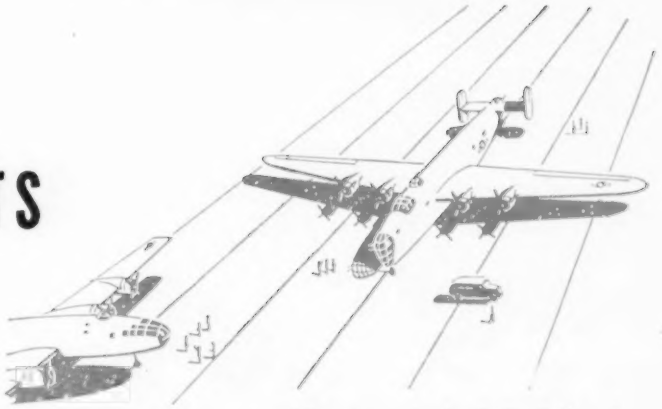
Gas to Gas Heat Exchanger. This type of Paracoil Heat Exchanger has many industrial uses for transfering heat between gases or liquids, or between gases and liquids. Unit illustrated constructed entirely of Inconel. Can be furnished in other alloys or carbon steel.

Liquid to Liquid Exchanger. Special liquid to liquid exchanger for counter current flow, six pass on both shell and tube sides. Most efficient design for crossing temperature conditions. Straight tubes easily cleaned.

SINCE 1915
Paracoil
HEAT TRANSFER EQUIPMENT

**DAVIS ENGINEERING CORPORATION**
**1066 EAST GRAND STREET, ELIZABETH 4, NEW JERSEY**

# FROM LANDING MATS TO AUTO PARTS



## DAYTON V-BELT DRIVE ABSORBS SHOCKS

### of starts and stops of huge press that exerts pressure of 192 tons

All during the war this huge mechanical press helped to make landing mats for emergency airfields. Now it is turning out auto parts. During these years this press has delivered its 192-ton blow tens of thousands of times. And each time the six Dayton V-Belts have helped to absorb the shocks of starting and stopping . . . without a single belt failure! Dayton V-Belts can stand such hard service because they are engineered to perform tough jobs, and built of *specialized* rubber for the particular work they have to do. Preferred by industry for power transmission drives, Dayton V-Belts can also solve your power drive problems. Write

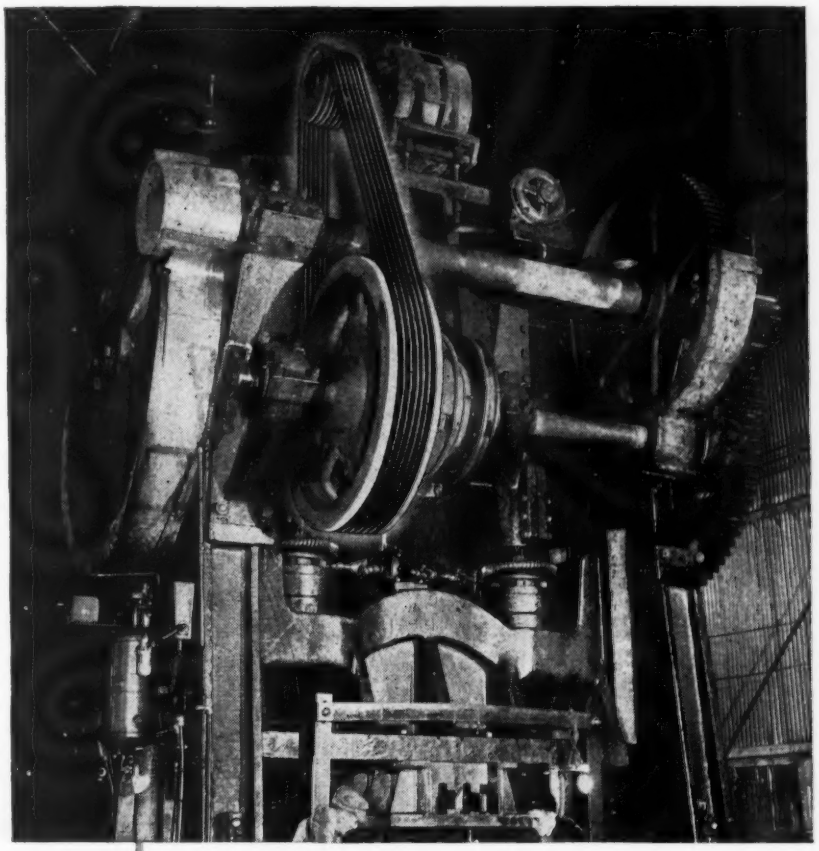
**THE DAYTON RUBBER MANUFACTURING COMPANY**
DAYTON 1, OHIO

★

**ATTENTION POWER TRANSMISSION ENGINEERS:**

There is a mill supply house near you that stocks Dayton V-Belts. A representative of this organization will gladly discuss your power transmission drive problems with you. Look for this company under the trade name listing, "Dayton V-Belts" in the yellow pages of your telephone directory.

★



WRITE FOR THIS DAYTON CATALOG TODAY:

The Dayton No. 280 Catalog has 384 pages of data that make selection of Dayton V-Belt Drives simple and easy. It's free. Write The Dayton Rubber Manufacturing Company, Dayton 1, Ohio.

Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

THE MARK OF TECHNICAL EXCELLENCE IN NATURAL AND SYNTHETIC RUBBER

THE WORLD'S LARGEST MANUFACTURER OF V-BELTS

SOFT

TOUGH

DUCTILE

# Globeiron

## SEAMLESS TUBING

INDUSTRY asked for a seamless tubing with high magnetic permeability, uniform ductility, softness, toughness, and corrosion resistant properties. We supplied it in Globeiron Seamless Tubing. Because of its right combination of all these properties, Globeiron is extensively used in the electrical and radio industries; housings for generators and motors are frequently fabricated from Globeiron. It is extensively used for many pressure tubing applications. It can be worked hot or cold.

Some of your tubing problems may be profitably solved through the use of Globeiron Seamless Tubing. Globe engineers, Globe laboratory facilities are at your service. Write for Bulletins 109A and 113.

**GLOBE STEEL TUBES CO.**
**MILWAUKEE 4, WIS., U. S. A.**

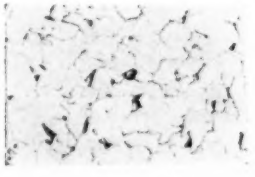
5028

*Globeiron is a high purity, low carbon iron, often known as "ingot iron". The physical properties of Globeiron make it ideal for difficult forming operations.*

## High Magnetic Permeability

**(Generator Housing)**

*Housing for generators and motors may be thinner and lighter when made of Globeiron. The shell of the Dynamotor shown here is an example of Globeiron adaptability.*

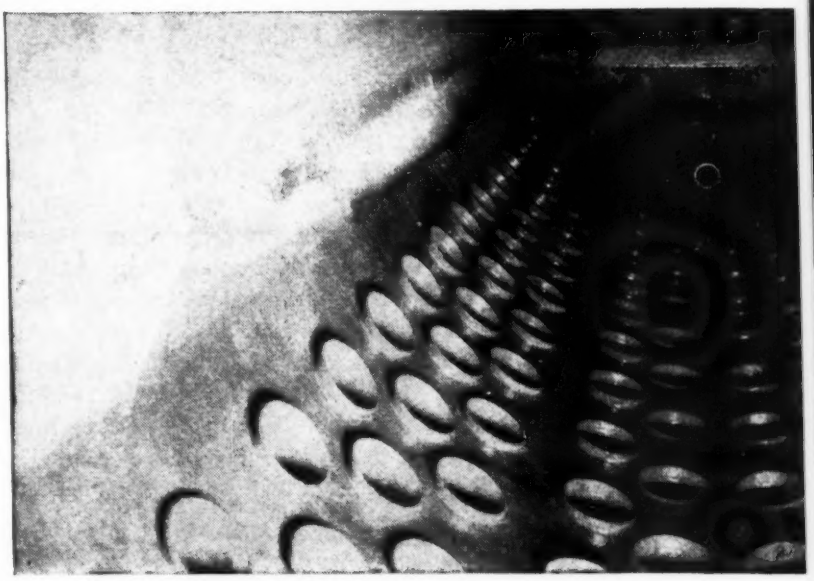


*Under the microscope (mag. 200x Nital Etch) Globeiron shows a uniform structure of almost pure ferrite with only occasional patches of pearlite.*

★ PRESSURE TUBES
★ MECHANICAL TUBING
★ CONDENSER & HEAT EXCHANGER TUBES ★ GLOBEIRON HIGH PURITY IRON SEAMLESS TUBES
★ GLOWELD WELDED STAINLESS STEEL TUBES ★ SEAMLESS STAINLESS STEEL TUBES

# DOWELL

## this boiler was thoroughly cleaned the chemical way



Power plant engineers—men who are responsible for *efficient operation* of heat-exchange equipment in leading industries have welcomed the Dowell chemical method of removing scale and sludge.

Plants everywhere are learning that the Dowell method is safe, economical, rapid—and thorough.

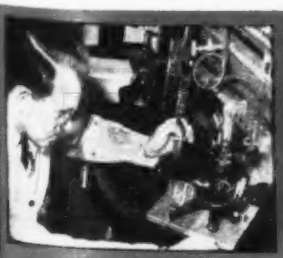
Dowell specialists do the entire job. They pre-inspect the equipment to be cleaned. They chemically analyze samples of deposits found in *your* plant. And after this careful preparation, they bring with them the proper chemicals and adequate equipment to perform completely every stage of the treatment—to insure effective removal of the insulating deposits.

*For complete details, call the nearest Dowell office for a free estimate. Ask for your copy of "More Power to America's Industry"—new color booklet which explains and illustrates Dowell's thorough chemical cleaning service.*

DOWELL INCORPORATED • TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

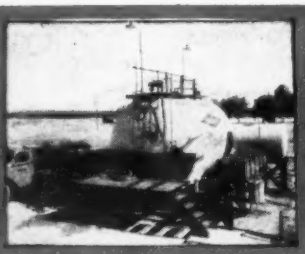
New York • Philadelphia • Baltimore • Buffalo • Cleveland • Cincinnati
Chicago • Detroit • St. Louis • Houston • Kansas City • Wichita
Mt. Pleasant, Michigan • Salem, Illinois
Long Beach, Casper: Dowell Affiliate—International Cementers, Inc.

## SPECIALISTS IN CHEMICAL CLEANING SERVICE



Dowell's experienced industrial engineers are backed by the complete research and technical facilities of The Dow Chemical Company.

Dowell's equipment is modern and complete—scientifically designed. Treating stations and chemical warehouses conveniently located.



Dowell cleaning solvents are "tailor-made" to fit each job. All ingredients are of the highest quality, chosen for best results in your plant.

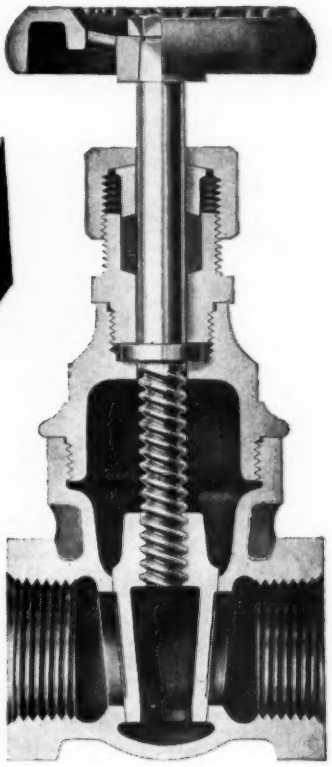
**DOWELL**

FOR INDUSTRIAL CHEMICAL SERVICE

# *Every feature you want in a*

# BRONZE GATE VALVE

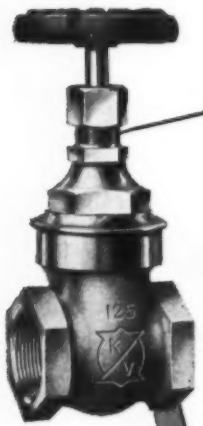
**is in this KENNEDY DESIGN**



Simplicity . . . and sturdiness . . . these are the two outstanding design characteristics of Kennedy Bronze Gate Valves. There are no small, quick-wearing parts that might cause undue maintenance expense. The heavy bodies and bonnets, large stems with heavily proportioned contact threads, long-proven disc mechanisms, large bonnet hexes and wide pipe-end hexes all combine to provide extra strength, long life and low maintenance expense.

You can obtain these extra-value Kennedy Bronze Gate Valves in a complete range of sizes and for all pressures up to 300-lb. steam. They are available with non-rising stem, rising stem, quick-operating lever and outside screw and yoke . . . screwed and flanged . . . inside screwed bonnet and union bonnet . . . a type for every standard requirement. The 240 page Kennedy Catalog describes these valves in detail . . . your copy sent on request.

*Buy From Our Distributor*



## YOU WANT THESE VALVE FEATURES

**. . . you'll find them in this KENNEDY design**

1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
2. **Easy Operation . . .** Stem and stem contact surfaces are accurately threaded. Deep stuffing boxes permit tightness without undue pressure on packing. Large handwheel gives firm, comfortable grip.
3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

**THE KENNEDY VALVE MFG. CO.**
Elmira, New York

KV-113

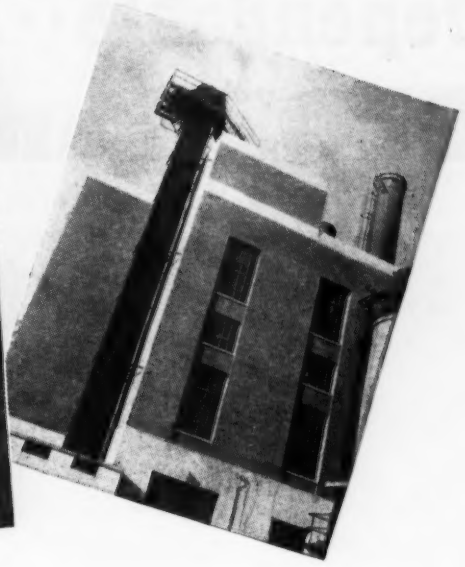
**KENNEDY** *valves - pipe fittings - fire hydrants*

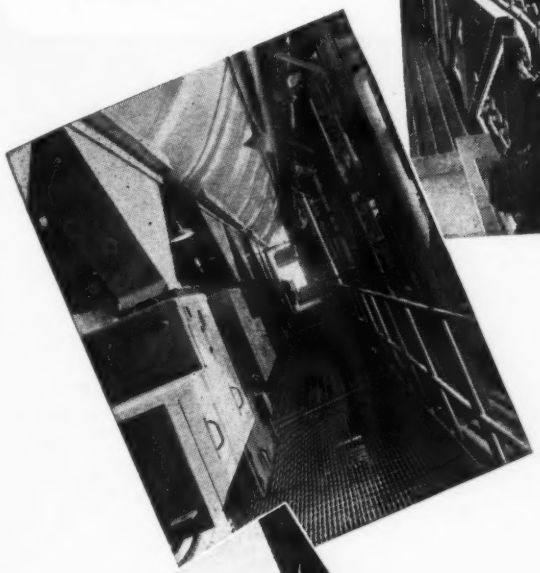
1—Bucket elevator hoisting coal to 600 ton bunker.

2—Flight conveyor over bunker.

3—Bunker, concentrating chutes and scales.

4—Chutes from scales and gates to pulverizer feeders.





Above: Ground storage elevator forming initial pile from which point coal is stored by bulldozer shown.

*Engineering the Equipment to fit the need*

# FAIRFIELD

## *Coal Handling* SYSTEM

Existing conditions—plant location—type of structure—all are factors in determining the most satisfactory method of handling coal in the modern power plant.

Shown is a typical example of how Fairfield engineered a complete coal handling system from car to storage to bunker to pulverizers—with minimum of labor required and with full automatic handling—at the rate of 75 tons per hour.

The plant has four 100,000 lb. boilers fired by pulverized coal. The coal is handled automatically from car by means of a track hopper — reciprocating feeder and bucket elevator and chute to initial pile for ground storage. A bucket elevator hoists coal to suspension type steel bunker inside the power plant from which concentrating chutes deliver it to automatic scales and gates to pulverizer feeders.

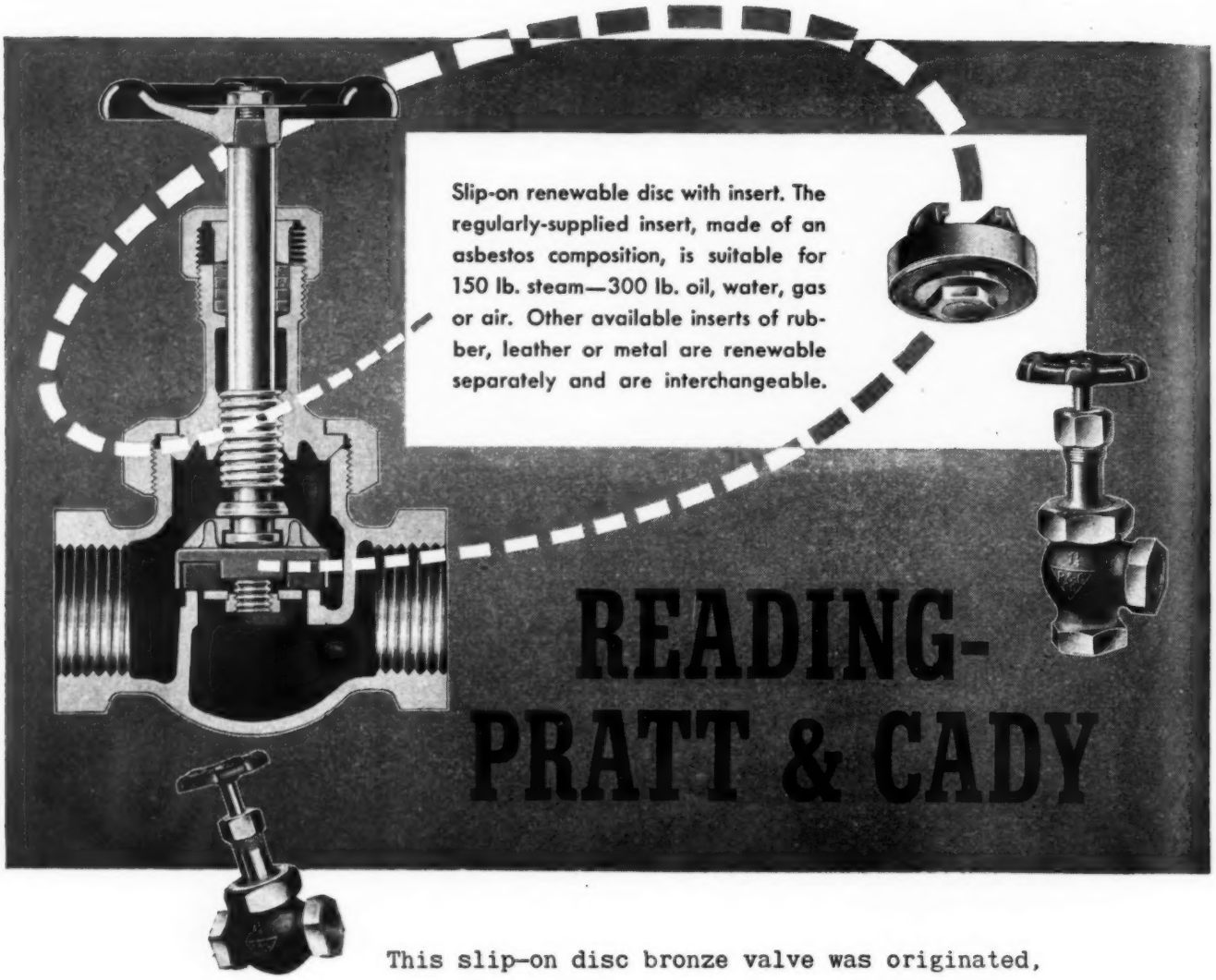
Consult Fairfield on your coal and ash handling systems. They have the experience—the engineering "know how"—the facilities for designing—building and erecting the complete system.

**THE FAIRFIELD ENGINEERING CO.**

*Builders of Coal and Ash Handling Equipment*

**320 CHICAGO AVENUE • • • MARION, OHIO**

# Dependable · · Long-lasting · · Versatile
# GLOBE and ANGLE Valves


Slip-on renewable disc with insert. The regularly-supplied insert, made of an asbestos composition, is suitable for 150 lb. steam—300 lb. oil, water, gas or air. Other available inserts of rubber, leather or metal are renewable separately and are interchangeable.
READING-
PRATT & CADY

This slip-on disc bronze valve was originated, developed and improved by Reading-Pratt & Cady. Essential to fullest performance are disc guides, cast in the bodies and machined, which extend down to the body seats. This is a versatile valve because a soft disc insert gives a tight closure in a globe type valve, basically a throttling type.

Reading-Pratt & Cady distributors are located in principal cities.

**Reading Cast Steel Valves and Fittings • Pratt & Cady Brass and Iron Valves**
**d'Este Automatic Regulating Valves**

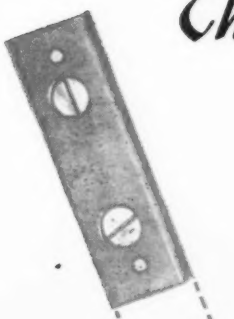
**ACCO**

Reading, Pa. • Atlanta • Chicago • Denver • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • Portland, Ore. • San Francisco • Bridgeport, Conn.

**READING-PRATT & CADY DIVISION**
**AMERICAN CHAIN & CABLE**

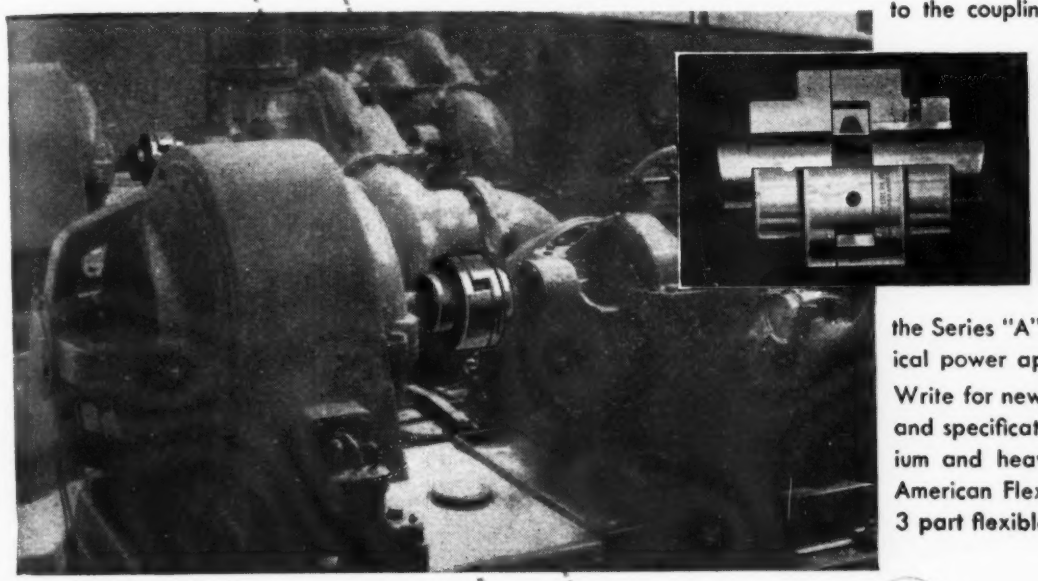
TRADE MARK

# *The Secret of* AMERICAN · *2+1=3*



**ONLY AMERICAN FLEXIBLE COUPLINGS** have two identical jaw flanges connected by one square floating center member. Three sturdy parts of the correct materials for each of the three applications - for average mechanical power applications - for medium torque transmitting applications - for most severe mechanical power applications.

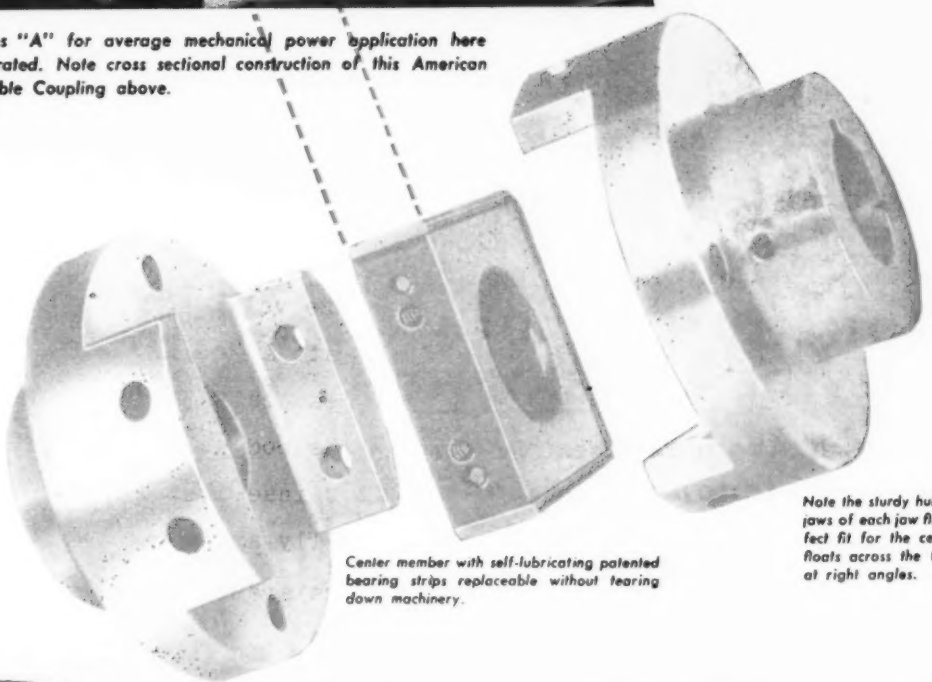
Illustrated here is the unique feature of the square floating center member . . . A centrifugal lubrication unit of high strength alloy metals. This replaceable self-lubricating bearing strip on each of the four sides of the center member assures long life to the coupling . . . Can be replaced without tearing down the unit or disturbing connected machines.



In this particular application illustrated, the jaw flanges are high strength alloy iron, and the center member is high strength alloy iron as well. This is the Series "A" for the average mechanical power application.

Write for new bulletin giving full details and specifications on this and the medium and heavy power applications of American Flexible Couplings . . . the only 3 part flexible couplings.

*Series "A" for average mechanical power application here illustrated. Note cross sectional construction of this American Flexible Coupling above.*



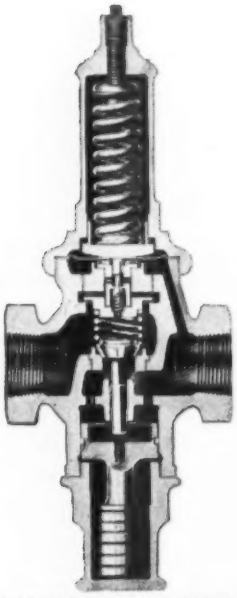
*Center member with self-lubricating patented bearing strips replaceable without tearing down machinery.*

*Note the sturdy hubs and the machined jaws of each jaw flange offering a perfect fit for the center member which floats across the face of each flange at right angles.*

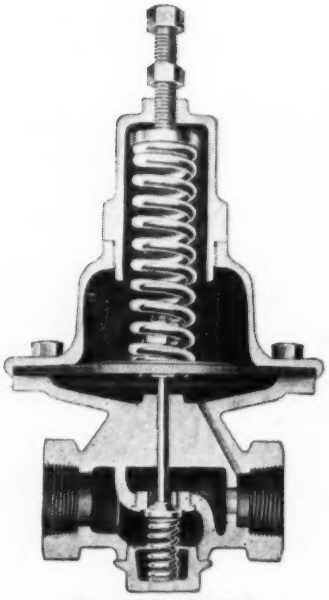
*Note the two parallel jaws of the jaw flanges which hold the center member.*

ZURN

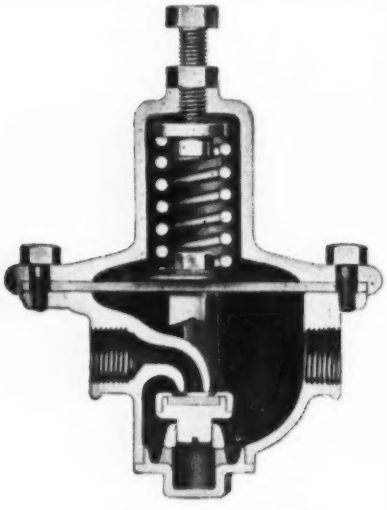
AMERICAN FLEXIBLE COUPLING CO.
DIVISION OF
J. A. ZURN MFG. CO., ERIE, PENNA.



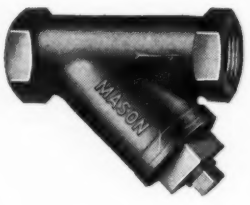
NO. 11 FOR STEAM SERVICE



NO. 33 FOR STEAM



NO. 227 FOR WATER




**USE A MASONEILAN STRAINER**

in all water, steam or air lines to protect valves, traps, etc., from scale, dirt or other foreign matter. These strainers are precision-built for long reliable service. They cost no more than others. Sizes ¼", 1½".

# MASONEILAN REGULATORS PROVIDE BIG SAVINGS

## *Through Accurate Performance, Less Maintenance and Long Life*

Noteworthy among the many performance advantages of Masoneilan Pressure Regulators are that they *reduce waste* by holding pressures where you want them . . . cut maintenance to the bone because of their rugged construction and simplicity of operation . . . reduce production delays by minimizing time-out for servicing. Masoneilan Pressure Regulators are available for steam, air and water reducing service.

Catalog 73 gives complete information on these and other types of regulators. Write for copy.

**MASON-NEILAN REGULATOR COMPANY**

1186 ADAMS STREET, BOSTON 24, MASS., U. S. A.

New York Chicago St. Louis Philadelphia Houston
Pittsburgh Tulsa Los Angeles Cleveland Atlanta San Francisco
Mason Regulator Co. of Canada, Ltd., Montreal, Canada

# *Mason-Neilan Equipment Stocked by:*

**Allen & Reed, Inc.**, Providence, R. I.
**Appleby Bros. & Whittaker,** Harrisburg, Penna.
**Atlantic Pipe & Supply Co.**, Boston, Mass.
**Babbitt Steam Specialty Co.,** New Bedford, Mass.
**Barclay Ayers & Bertsch Co.,** Grand Rapids, Michigan
**Barrett-Christie Co.**, Chicago, Ill.
**Berkshire Mill Supply,** Pittsfield, Mass.
**W. L. Blake & Co.**, Portland, Me.
**Boston Pipe & Fittings Co.**, Cambridge, Mass.
**Braman Dow & Co.**, Boston, Mass.
**Burns Bros.**, Syracuse, N. Y.
**Carolina Supply Co.**, Greenville, S. C.
**W. A. Case & Son Mfg. Co.**, Buffalo, N. Y.
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**Grinnell Co., Inc.**, Cranston, R. I.
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**Hamacher & Williams,** Milwaukee, Wis.
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**Chas. Millar & Son Co.**, Utica, N. Y.
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**Smith-Monroe Co.**, South Bend, Ind.
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**The Henry Walke Co.**, Norfolk, Va.
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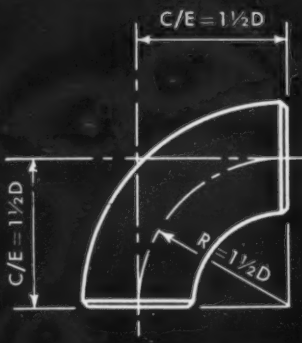
**Warren & Bailey Co.**, Los Angeles, Calif.
**Washburn-Garfield Co.**, Worcester, Mass.
**Woodward, Wight & Co., Ltd.**, New Orleans, La.
**The Young & Vann Supply Co.,** Birmingham, Ala.

MASONEILAN

# ONLY MIDWEST OFFERS A COMPLETE SELECTION OF 90° WELDING ELBOWS

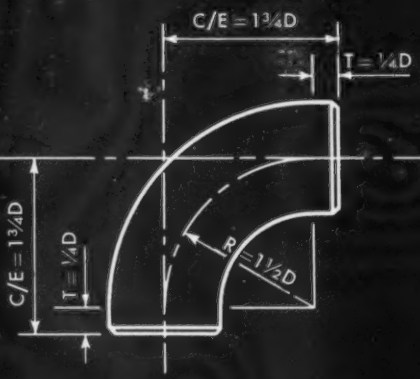
**1 LONG RADIUS AMERICAN STANDARD**




SIZES: 3/4" TO 12", INCLUSIVE

All dimensions conform to the American Standard for Steel Butt-Welding Fittings ASA B16.9. Unless order specifies otherwise, these "ASA Elbows" will be furnished.

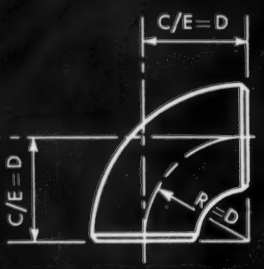
**2 LONG RADIUS LONG TANGENT**




SIZES: 2" TO 20", INCLUSIVE

Same radius as "ASA Elbows" but with long integral tangent on each end—an exclusive Midwest feature that saves time and pipe, and sometimes eliminates an extra weld.

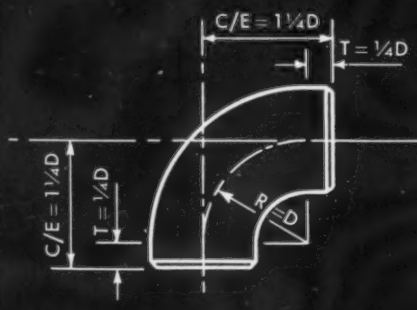
**3 SHORT RADIUS**




SIZES: 1" TO 12", INCLUSIVE

Where space limitations prevent the use of "ASA Elbows" or Midwest "Long Tangent" Elbows shown at left, these short turn elbows without tangents are recommended.

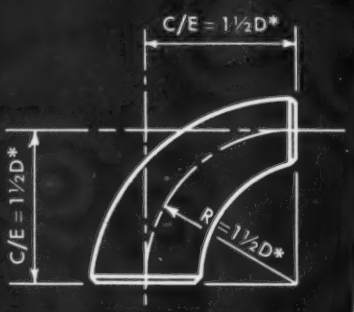
**4 SHORT RADIUS LONG TANGENT**




SIZES: 14" TO 24", INCLUSIVE

These OD sizes are short radius but have the exclusive Midwest long tangents that save pipe and make it possible to line up the fitting and pipe more quickly and accurately.

**5 LONG RADIUS REDUCING**




SIZES: 2" TO 12"*, INCLUSIVE

Only Midwest makes the reducing welding elbow which takes the place of a straight elbow and a reducer. It eliminates one weld, cuts installation cost, and reduces pressure drop.

**SYMBOLS:**

C/E = Center-to-End Dimension
D = Normal Pipe Size
R = Radius
T = Length of Tangent
*D = Dimension is Larger Pipe Size

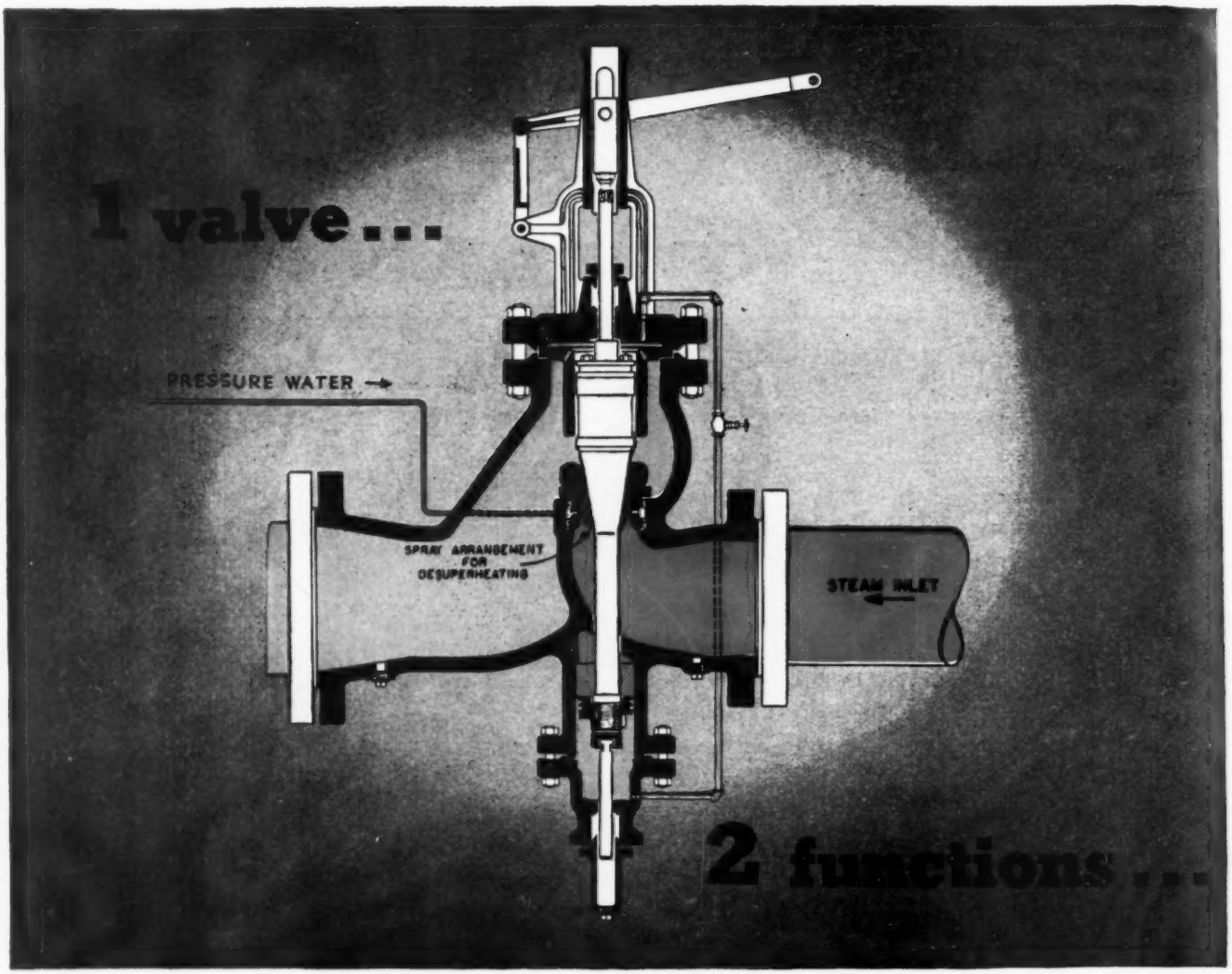
**MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS**

MIDWEST

**PIPING & SUPPLY CO., Inc.**

Main Office: 1450 South Second St.
St Louis 4, Mo.

Sales Offices: New York 7—30 Church St. Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St. • Distributors in Many Cities




# and many advantages

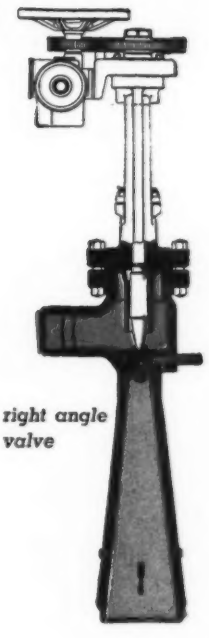
SK Combination Reducing Valves and Desuperheaters eliminate unnecessary equipment, permit automatic control of steam pressure and temperature, and reduce maintenance to the point where it is practically negligible. The easy, long-lived operation of these valves is a product of simple, sturdy, balanced construction. No separate desuperheaters are needed where the entire quantity of steam passing through the valve must be desuperheated.

The pressure regulator that positions the valve spindle, and the temperature regulator that controls the amount of desuperheater water injected, may be operated by air, oil or electricity.

Desuperheating water, supplied at a pressure of approximately 40 pounds above initial steam pressure, is injected at the point of highest velocity in the reducing valve. This results in a thorough mixture with the steam and eliminates the need for a separator.

The SK Combined Reducing Valve and Desuperheater will handle from 0 to 900,000 pounds of steam per hour and is designed to receive steam from high pressure boilers operating at 1800 pounds pressure and 950 degrees Fahrenheit and reduce it to any desired pressure and temperature. It is available as a straight valve or a right angle valve.

Write for Bulletin 8-R-D.



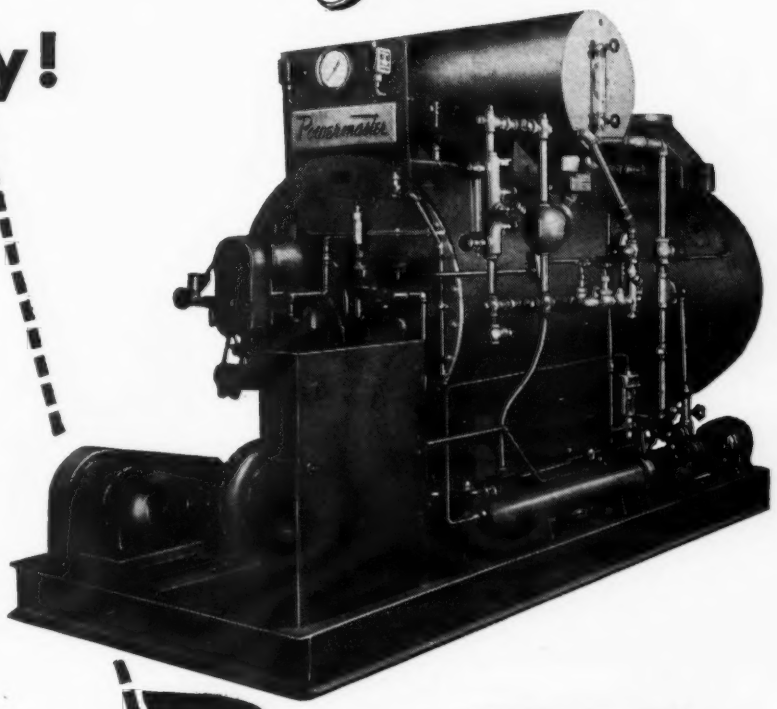
*. . . right angle valve*

## SCHUTTE & KOERTING COMPANY

1150 THOMPSON STREET, PHILADELPHIA 22, PA.

JET APPARATUS - HEAT TRANSFER EQUIPMENT - STRAINERS CONDENSERS AND VACUUM PUMPS - OIL BURNING EQUIPMENT - ROTAMETERS AND FLOW INDICATORS - RADIAFIN TUBES VALVES - SPRAY NOZZLES AND ATOMIZERS - GEAR PUMPS

# Get Full Steam Pressure in 18 Minutes Automatically!




**Find Out** how to get fast, efficient steam at lowest cost—full steam pressure in as little as 18 minutes . . .

**Learn How** you save as much as 50% of your valuable floor space through the Powermaster's compact, all-in-one-unit design . . .

**See Why** no stack is needed for draft—why the Powermaster requires only a small vent to carry off combustion gases . . .

**Discover** the Powermaster's exceptionally clean operation, enabling you to keep your boiler room spotless and dust-free . . .

**Get This** new Bulletin #1214 and learn how the 60-year-old O & S policy of "one-company responsibility" saves you plenty of steam generating "headaches" . . .

## the Powermaster

### AUTOMATIC STEAM GENERATING UNIT

Designed for light-oil and heavy-oil firing, the Powermaster gives you dependable steam with the flick of a switch. Boiler, oil burner, condensate return and control systems are combined in one compact unit. Tested to A. S. M. E. standards, shipped complete and installed in a few hours.

## ORR & SEMBOWER INC.

*READING, PENNSYLVANIA*

**District Offices: BOSTON-CHICAGO-CLEVELAND-NEW YORK-PHILADELPHIA-SEATTLE**

Powermaster
AUTOMATIC-STEAM GENERATING UNITS
for Light and Heavy Oil Operation
Starts with a Flick of the Switch!
ORR & SEMBOWER, INC.

**PLEASE CLIP AND MAIL THIS COUPON**

ORR & SEMBOWER, INC.
892 MORGANTOWN ROAD
READING, PENNSYLVANIA

Please mail the new 8-page O & S Powermaster Bulletin #1214, without obligation, to:

COMPANY _____

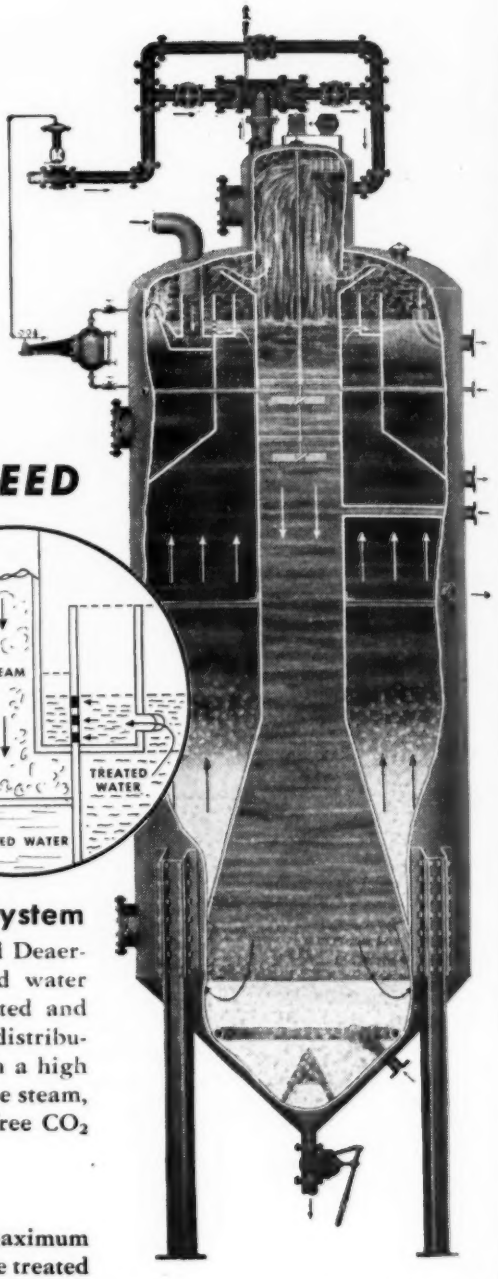
ADDRESS _____

CITY _____ ZONE # _____ STATE _____

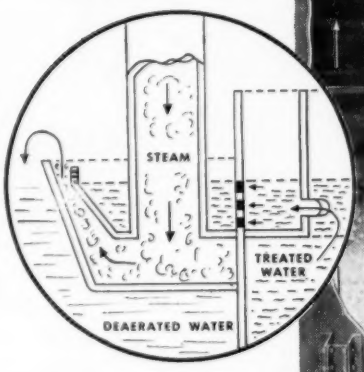
ATTENTION OF _____

WATER CONDITIONING *Facts* WORTH KNOWING

*No. 2 in a series*



# WHY DEAERATION OF BOILER FEED WATER IS NECESSARY




▶The conditioning of water for boiler feed should not stop at softening if maximum efficiency of operation is to be maintained. The softened water still contains corrosive gases, such as oxygen and free $CO_2$, which cause pitting and corrosion in boilers and steam lines. To remove these equipment-damaging gases, deaeration of the treated water and the condensate return is necessary. This process should be carried out in conjunction with softening and—in the interest of efficiency—in the softener unit.

## Graver Hot Process Softening and Deaeration System

This equipment is a single, compact unit with built-in Heating and Deaerating facilities to perform the complete operation of boiler feed water conditioning. In the operation of the deaerating system the heated and treated water from the sedimentation tank flows by gravity into a distribution tray, and is then discharged over a long narrow weir through a high velocity jet of steam which reheats the water to the temperature of the steam, breaking it into minute particles, thus releasing the oxygen and free $CO_2$ gases as shown in the diagram.

## Graver Deaerator Is Highly Effective

The Graver Deaerator is effective at extremely low flow and at its maximum capacity. With this equipment $CO_2$ gas is entirely eliminated from the treated water and oxygen is removed to 0.003 cc per liter, as determined by standard oxygen test methods. The Graver Deaerator is designed to eliminate moving parts, springs or lever arms, subject to attack by corrosion.

Graver Preheaters and Deaerators are also available as separate units for heating and deaeration of boiler feed water. They can be furnished with storage tanks for any given capacity.

For complete details on this or any other type water conditioning equipment consult Graver. Write, wire or phone for immediate attention. There's no obligation.

*Cross section view of Graver Hot Process Water Softener with built-in Deaerating equipment.*

GRAVER WATER CONDITIONING EQUIPMENT

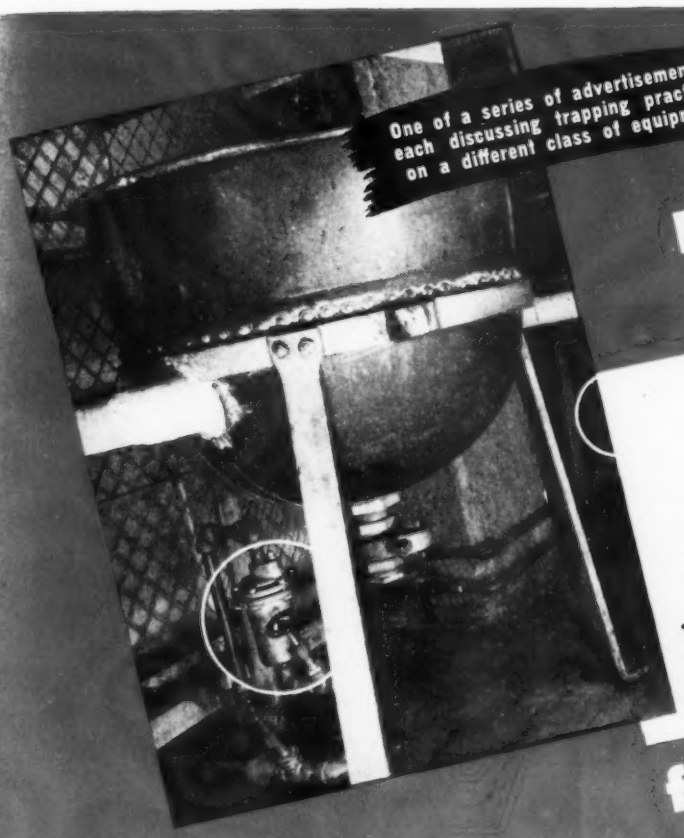
*Process Equipment Division of*

**GRAVER TANK & MFG. CO., INC.**

**General Offices: 4809-25 Tod Ave., East Chicago, Ind.**

NEW YORK CHICAGO CATASAUQUA, PA. TULSA, OKLA.
PHILADELPHIA PORT ARTHUR, TEX.

Hot Process Water Softeners • Zeolite Water Softeners • Water Filters
Taste and Odor Removal Filters • Iron Removal Filters • Oil Removal Filters • Chemical Mixing and Proportioning Equipment
Demineralizers



One of a series of advertisements, each discussing trapping practice on a different class of equipment.

# HOW TO TRAP STEAM JACKETED EQUIPMENT for faster heating

## User Reports 75% Reduction in Cooking Time

Correct drainage of condensate from steam jacketed kettles, vats, cylinders, pans and similar equipment can save time and save steam. The table below contrasts proper trapping with drainage through a cracked valve. This is substantiated by other reports: a Chicago firm reduced cooking time on kettles 75%—from 40 minutes to 10 minutes; a California packing company reduced average cooking time from 27 to 17 minutes; other companies report similar benefits.

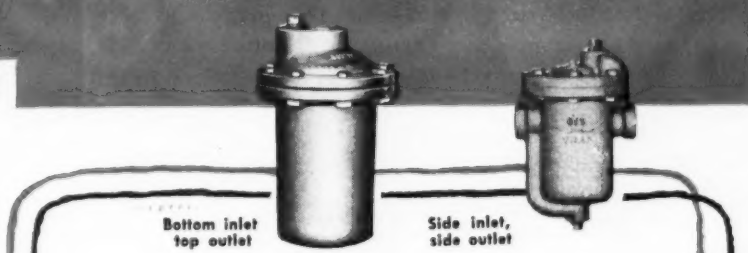
The reasons for these results are two:

1. Armstrong Trap design — no steam leakage, big air venting capacity, ability to discharge condensate as fast as it accumulates regardless of temperature.

2. Armstrong recommendations — covering trap selection and installation practice. Based on tests and experience on thousands of installations.

Armstrong traps are sold through leading distributors everywhere on a basis of "satisfaction *guaranteed*". For better trapping, write to

**Armstrong Machine Works**
**812 Maple St., Three Rivers, Mich.**




### Some Tips Regarding Drainage of Steam Jacketed Equipment*

- Use one trap for each unit.
- Install trap close to and below unit.
- Use ample size steam supply lines.
- Size return lines to prevent excessive back pressures.
- For *fast* heating use an Armstrong trap with extra air handling capacity.
- For *medium* speed heating use standard Armstrong trap.
- For *slow* cooking use smaller size trap.

* Complete data with engineering charts and tables given on page 29 of the *Armstrong Steam Trap Book*. Ask for a copy.

Table showing cost of various sized steam leaks at 100 pound pressure (assuming steam costs 50 cents per 1000 lbs.)

| Size of Orifice | Lb. Steam Wasted Per Month | Total Cost Per Month | Total Cost Per Year |
|---|---|---|---|
| 1/2" | 835,000 | $417.50 | $5,010.00 |
| 1/4" | 210,000 | 105.00 | 1,260.00 |
| 1/16" | 13,200 | 6.60 | 79.20 |
| 1/32" | 3,400 | 1.70 | 20.40 |

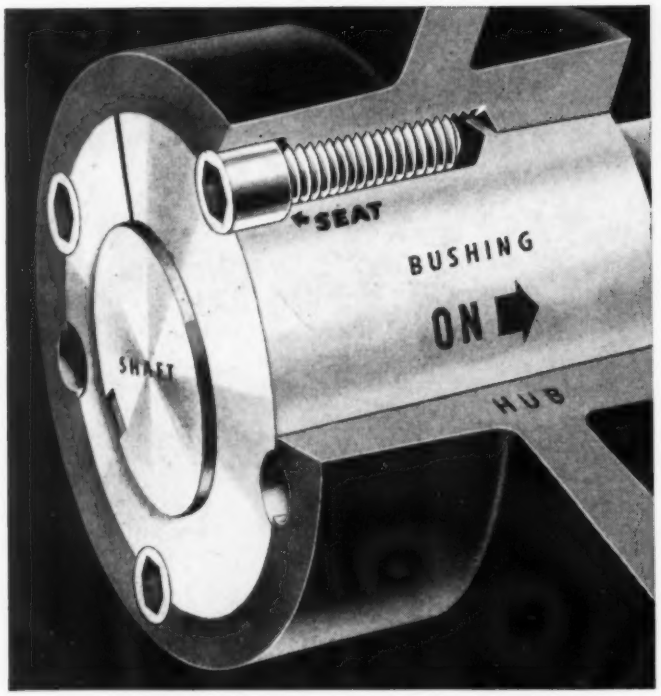
(For steam at 50 lbs. pressure, the waste is about 75% of the above figures: at 20 lbs., it is about 50%; and at 5 lbs., the loss is about 25%.)

**ARMSTRONG *Inverted Bucket* STEAM TRAPS**

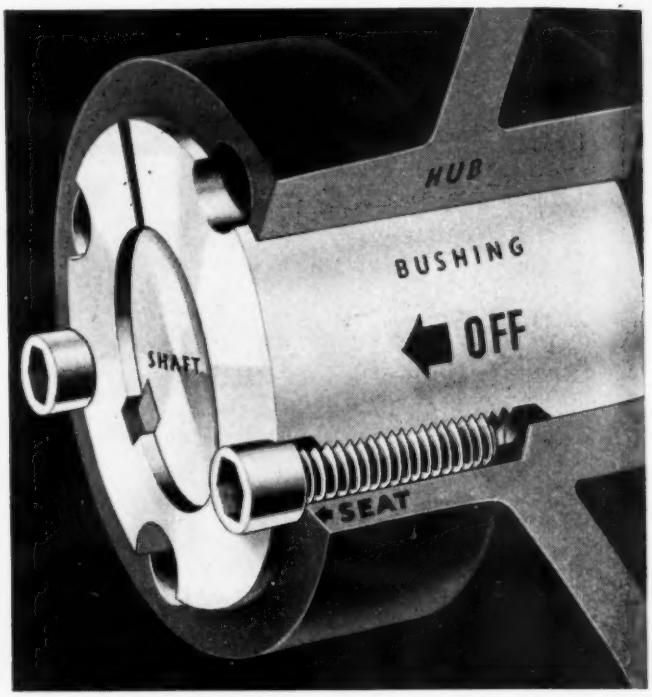
*Over a Million in Use...For Power...Process...Heating*

# HERE'S HOW IT WORKS

# ...SIMPLE, ISN'T IT?




Note that only the HUB is threaded. Screw-head seats itself against offset in bushing. As the screw is turned, the sheave is drawn up—wedged—with a firmness equivalent to a shrunk-on fit, whether the shaft is standard or normally undersize.




Note that here only the BUSHING is threaded. Screw-head seats itself against face of hub. As the screw is turned, the wedge is disengaged. Due to its steep taper, the bushing disengages with less effort than in any other sheave.

# NEW TAPER-LOCK BRAND SHEAVE

*Patent applied for*

***THE SYMBOL THAT CAME TO LIFE***

The man who walks into your factory wearing this symbol is the living embodiment of a service which gives you the correct answer to your problems in efficient mechanical transmission of power. He is the Dodge Transmissioneer.

Here is the simplest, surest mechanism ever devised for holding wheels to shafts. No flange. No collar. No protruding parts. Easy on—easy off—and holds fast! Breaks all speed records in mounting and demounting. Slip it on, line it up and tighten *while sighting*... A complete range of stock sizes, from Dual Duty to C and D. For details call the Dodge Transmissioneer, your local Dodge distributor. Look for his name under "Power Transmission Equipment" in classified phone directory.

**DODGE MANUFACTURING CORPORATION, MISHAWAKA, INDIANA**

**DODGE**
**MISHAWAKA**

Copyright, 1946, Dodge Mfg. Corp.

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS

# Here is an atomizer with a capacity range of 8 to 1

# ...the ENCO wide range MECHANICAL ATOMIZER

It takes four ordinary atomizers to match the performance of one ENCO Wide Range Mechanical Atomizer. With a capacity range of 8 to 1, this atomizer is able to reduce the normal number of burner tip changes between low bank loads and high peak loads.

Burner tip changing time is substantially cut —boiler room operating costs go down. And, in these days of close-margin production that means much.

The ENCO Wide Range Mechanical Atomizer permits operation on oil or in combination with pulverized coal and gas burners. It can handle any grade of liquid fuel prepared for mechanical atomization. AND — no matter how sudden the load change, it provides means for instant adjustment, assuring safe operation at all loads.

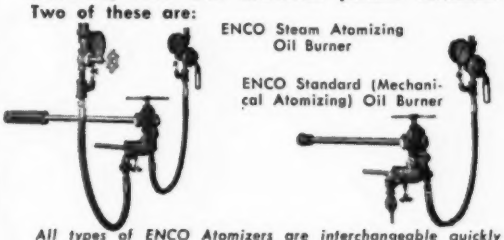
The ENCO Wide Range Mechanical Atomizer can help you, too, by making valuable dollar-savings in production time.

*Write today for additional information.*

A complete line of gas and liquid fuel burners are designed and built by ENCO to meet the wide range of capacity requirements of steam plants, refineries, kilns and industrial process furnaces. Two of these are:

ENCO Steam Atomizing Oil Burner

ENCO Standard (Mechanical Atomizing) Oil Burner



*All types of ENCO Atomizers are interchangeable quickly and easily.*

**The Engineer Company also produces:**

**Enco Streamline Baffles**
**Enco Air Registers**
**Enco Fuel Oil Pumping and Heating Units**
**Enco Automatic Oil-Electric Ignition System**
**Enco Automatic Combustion Control**

## THE ENGINEER COMPANY

**75 West Street**
**New York 6, New York**

**Canadian Representative:**
**F. J. Raskin, Ltd., 370 Rachel E., Montreal, P. Q.**

EC-488

# *Twelve Years of Trouble-free Service—*
# *—with* CRYSTOLON BRICK

(left) CRYSTOLON Brick after three years of service in a school boiler furnace look the same as the day they were installed.

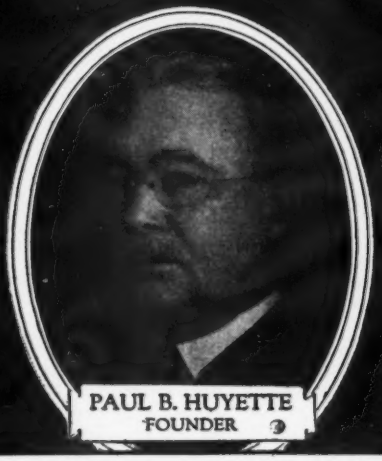
(right) Unretouched photograph of the same CRYSTOLON Brick after 12 years of service. When soot was scraped way, the surface of the brick was found to be in perfect condition.

CRYSTOLON Brick are densely made of silicon carbide plus a minimum of a refractory bond. These highly refractory brick are physically rugged, chemically inert and resistant to abrasion. Coal ash slag cannot penetrate the hard, dense surface of CRYSTOLON Brick and this makes clinker removal a short, easy operation as well as guaranteeing long, trouble-free service.

## NORTON COMPANY — Worcester 6, Mass.

**NORTON** Longer Lasting **REFRACTORIES**

# THE PAUL B. HUYETTE CO., Inc.



PAUL B. HUYETTE
FOUNDER

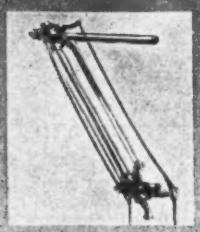
1896 50th ANNIVERSARY 1946

The PAUL B. HUYETTE CO., Inc. celebrates its 50th Anniversary this year, and takes this opportunity to express its appreciation of the patronage it has enjoyed from the Power Plant industry during the half-century just completed. Great changes have taken place in that industry since young Paul B. Huyette founded this business in 1896 . . . and who knows what tremendous changes will take place in the *next* 50 years? But it is our purpose to see that there will be no change in the quality of Huyette products and Huyette service.

S. Louis Huyette
President

MANUFACTURERS OF "P. B. H." BRONZE WATER GAUGE VALVES FOR BOILERS, TANKS AND OTHER VESSELS • ALL IRON GAUGE VALVES FOR CHEMICAL APPLICATIONS • GAUGE COCKS • GAUGE GLASS PROTECTORS • BOILER TUBE CLEANERS • BOILER WALL COATING • STOKING TOOLS • DRIP FUNNELS

and



## "P.B.H." TILTVIEW INCLINED BOILER WATER GAUGE

One of the Huyette boiler room specialties that is extremely popular is the P.B.H. Tiltview Boiler Water Gauge, designed for easier visibility where gauges are high above the floor. It is made with screwed or flanged adapters in connection with the regular P.B.H. Water Gauge—a standard in the boiler room for a generation.

401 N. Broad Street
PHILADELPHIA 8, PA.

1896 1946
THE PAUL B. HUYETTE CO. INC.
50th Anniversary

205 E. 42nd Street
NEW YORK 17, N. Y.

# COPPER ALLOY BULLETIN

**MARINE AND POWER EDITION**

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

*Prepared by Bridgeport Brass Company* "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*


## Condenser and Heat Exchanger Tubes

### *Wide Range of Corrosion-Resistant Alloys*

The selection of the most economical and satisfactory condenser or heat exchanger tubes is a problem which every power plant engineer must answer from time to time. The frequency with which this matter comes up for consideration depends upon the size and the age of the plant, and the severity of the corrosive conditions. Our object is to present information, as briefly as possible, which will help the engineer in his selection of an alloy which will give the greatest satisfaction and longest life.

During the past thirty years the replacement of corroded condenser and heat exchanger tubes has become more complicated because of the many changes which have taken place during this period. Thirty years ago there were essentially only four commercial copper-base alloys to choose from—Copper, Muntz Metal, 70-30 Brass and Admiralty. Today there are at least a dozen different alloys.

#### Influence of Alloy Composition

Corrosion research data show that small additions of certain metals to copper base alloys have a very marked influence on the rate of corrosion from sea water, fresh water, brackish water and polluted water. Tin, aluminum, nickel, zinc, iron, arsenic, etc., alloyed with copper singly or in combination, have resulted in the development of superior alloys.

#### Factors Influencing Rate of Corrosion

In a number of instances, the replacement of worn-out, corroded condenser and heat exchanger tubes with tubing made from an alloy which had previously given many years of service, has not worked out as well as expected. There are many factors which may contribute towards this situation. We find that harbor waters are becoming more and more polluted by industrial wastes and sewage. Again, operating conditions in many instances are more severe—the condenser service hours per year have in many instances been increased considerably, sometimes approaching almost continual operation. Frequently, this has a very pronounced effect on the life of the tubes, depending upon the alloy and seasonal variation in the composition of cooling water or steam. Also, greater quantities of water at higher velocities may be forced through condensers either to raise their efficiency or, in some cases, to make possible their use when larger condensers are actually needed. The use of larger capacity pumps may increase waterflow and turbulence.

In cases where chlorination is successfully practiced on old tubes, it is found that chlorination used on new tubes sometimes prevents the formation of a tenacious protective corrosion film, and contributes to premature failure. When changes in operation are contemplated, it is well to consider their possible effect on tube life and select the alloy which will be the most satisfactory one for the new conditions.

*Duronze IV*—One of the finest condenser tube alloys. Excellent corrosion resistance to sea water, and polluted brackish water. Highly recommended for seaboard power plants.

*Cupro-Nickel 70-30*—Excellent corrosion resistance to sea water; resists impingement corrosion from high water velocities. Good resistance to stress corrosion and higher operating temperatures. Most resistant of this group of copper-base alloys to the action of ammonium hydroxide.

U. S. Navy specifies this alloy for war ships and other vessels.

*Cuzinal (aluminum brass)*—Resists impingement corrosion from high velocity and trapped air bubbles in sea water.

*Arsenical Admiralty*—Good general corrosion resistance to sea water. Resists dezincification. Recommended for low water velocities only.

*Red Brass*—Excellent-to-good corrosion resistance to most inland fresh waters. Practically immune to dezincification.

*Arsenical Muntz Metal*—Good corrosion resistance to fresh waters. Contains arsenic as a dezincification inhibitor.

*Arsenical Copper* — Excellent-to-good corrosion resistance to most inland fresh waters.

For more complete information, technical data and the results of corrosion studies, write for 112-page Condenser Tube Manual. For assistance in selecting the most suitable condenser tube alloy, contact our Technical Service Department through your nearest Bridgeport office.

### CONDENSER AND HEAT EXCHANGER TUBES

| | | Duronze IV | Cupro Nickel 70-30 | Cuzinal | Arsenical Admiralty | Red Brass | Arsenical Muntz | Arsenical Copper |
|---|---|---|---|---|---|---|---|---|
| **ANALYSIS** | | | | | | | | |
| Copper | % | 94.25 | 68.85 | 77.0 | 71.0 | 85.0 | 62.0 | 99.6+ |
| Aluminum | % | 3.5 | | 2.0 | | | | |
| Tin | % | | | | 1.0 | | | |
| Zinc | % | | | 20.93 | 27.97 | 15.0 | 37.9 | |
| Phosphorus | % | | | | | | | 0.02 |
| Arsenic | % | .25 | | .02 | .03 | | 0.1 | 0.3 |
| Nickel | % | | 30.60 | | | | | |
| Iron | % | | .40 | | | | | |
| Manganese | % | | .75 | | | | | |
| **MECHANICAL PROPERTIES** | | | | | | | | |
| Ten. Strength psi | Hard* | | | | | | | 40,000 |
| | Soft | 60,000 | 60,000 | 60,000 | 53,000 | 44,000 | 56,000 | 32,000 |
| Yld. Strength psi (@½% extens. under load) | Hard* | | | | | | | |
| | Soft | 22,000 | 25,000 | 27,000 | 22,000 | 18,000 | 23,000 | |
| Elongation % in 2" | Hard* | | | | | | | 25 |
| | Soft | 60 | 45 | 55 | 65 | 45 | 50 | |
| Rockwell Hardness | Hard* | | | | | | | F77 |
| | Soft | F78 | F80 | F77 | F75 | F71 | F82 | |
| **PHYSICAL CONSTANTS** | | | | | | | | |
| Melting Pt. (Liq)°F | | 1940 | 2260 | 1780 | 1720 | 1880 | 1660 | 1981 |
| Density, lbs./cu. in. | | .295 | .322 | .301 | .308 | .316 | .303 | .322 |
| Coeff. Therm. Exp. per °F from 77°F to 572°F x10-6 | | 10.0 | 9.0 | 10.3 | 11.2 | 10.4 | 11.6 | 9.8 |
| Thermal Conduct. Btu/sq ft/ft/hr/°F @ 68°F | | 46 | 17 | 58 | 64 | 92 | 71 | 112 |
| Elec. Cond. % IACS @ 68°F Soft | | 17.0 | 4.6 | 23 | 25 | 37 | 28 | 45 |
| Mod. of Elas. (Tension) psi. | | 17,500,000 | 22,000,000 | 16,000,000 | 16,000,000 | 17,000,000 | 15,000,000 | 17,000,000 |
| **FABRICATION PROPERTIES** | | | | | | | | |
| Machinability Rating** | | 20 | 20 | 30 | 30 | 20 | 40 | 20 |
| Cold Working | | G | G | E | E | E | F | E |
| Hot Working | | G | G | F | F | G | E | E |
| Hot Working Range °F | | | 1700-1900 | 1400-1600 | 1200-1450 | 1450-1650 | 1150-1450 | 1400-1600 |
| **SPECIFICATIONS** | | | | | | | | |
| A.S.T.M. | | B111-Al Bronze | B111-70-30 Cupro-Nickel | B111-Al Brass Type B | B111-Admiralty Type B | B111-Red Brass | B111-Muntz | B111-Arsenical Copper |
| Federal | | | | | WW-T-756 | | | |
| Navy | | | 44T39A 44T40Int. | | 44T7 Int. | | | |
| Army | | | | | | | | |
| AMS | | | | | | | | |

* Hard temper—values are for temper suitable for condenser installation.
** Machinability rating—free cutting brass=100.
E—Excellent G—Good F—Fair P—Poor
All figures are nominal values and should not be used as specifications.


"Bridgeport" BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

ANOTHER EXAMPLE OF JOHNSON INDIVIDUAL ROOM CONTROL

# SAVE FUEL IN "DARK" OFFICES

## with JOHNSON *Automatic* Dual *Temperature* CONTROL

**Public Service Building, Portland, Oregon. A. E. Doyle and Associates, architects. Kendall Heating Co., mechanical contractors.**

SINCE 1928, with Johnson *Dual* control of room temperatures, the Public Service Building in Portland, Oregon, has saved countless tons of fuel which a building of that size otherwise would have consumed. When the day's work is done, a reduced economy temperature is maintained in the rooms which are not in use. Tenants who work "overtime" merely push a button on the Johnson *Dual* thermostats in their offices. Thus, only the occupied spaces, suggested by the lighted windows in the illustration, are heated to 70°.

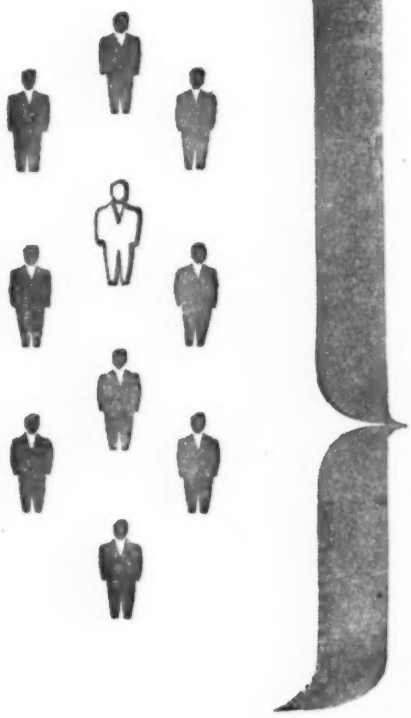
There are 274 Johnson *Dual* thermostats which control the Johnson valves on 440 radiators in this modern office building. Each of those thermostats is arranged to maintain, automatically, either of two temperatures—a suitable "occupancy" temperature of, say, 70°, and reduced "economy" temperature for non-occupancy hours. At the close of the normal business day, all of the thermostats in the building are set to the lower temperature, by a clock or manual switch at the operating engineer's station. Tenants who return to work in the evening restore the occupancy temperature setting readily, at their own thermostats. Later on, the central switch again resets the system to operate at the economy temperature level for the rest of the night.

Temperature comfort for each tenant is modern building service. Substantial fuel saving for building budgets is modern building management. All buildings, new or old, find individual room temperature control extremely valuable. Regardless of climatic conditions, or of the particular problems involved, Johnson Automatic Temperature Control systems are designed and built to "fit the need."

Johnson designs, manufactures, installs and services its automatic temperature control systems. Completing the whole job is the proved method for assured satisfaction. Whatever the problem in automatic regulation of heating, ventilating and air conditioning, Johnson engineers are prepared to cooperate. The Johnson nation-wide organization places experts near by. Consultation does not obligate. Let us talk over your control problems with you, now. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin, Direct Branch Offices in Principal Cities.

**JOHNSON** *Automatic Temperature and Air Conditioning* **CONTROL**

DESIGN • MANUFACTURE • INSTALLATION • SERVICE



# 9 OUT OF 10 *want* THE PAYROLL SAVINGS PLAN CONTINUED!

Thanks to the cooperation and encouragement of America's industrial executives, 85 million bond holders have bought U.S. Bonds in the greatest savings program in history. Employees who have purchased billions of dollars of these bonds during the war now want to continue monthly purchases of savings bonds. Specific evidence of this desire to continue saving for personal security and prosperity through the Payroll Savings Plan was recently revealed by a survey which disclosed that 90% wanted the Plan continued.

Every employer can write in his own set of reasons why the Payroll Savings Plan should be continued as a part of his personnel relations program, but the principal advantages are obvious:

***A large reservoir of national savings; a strong and stable bulwark against inflation.***

***An "automatic" thrift habit for the worker; to increase contentment and satisfaction in his job.***

***An opportunity for the employee to maintain his "share in America" with the safest, easiest, most profitable investment he can make.***

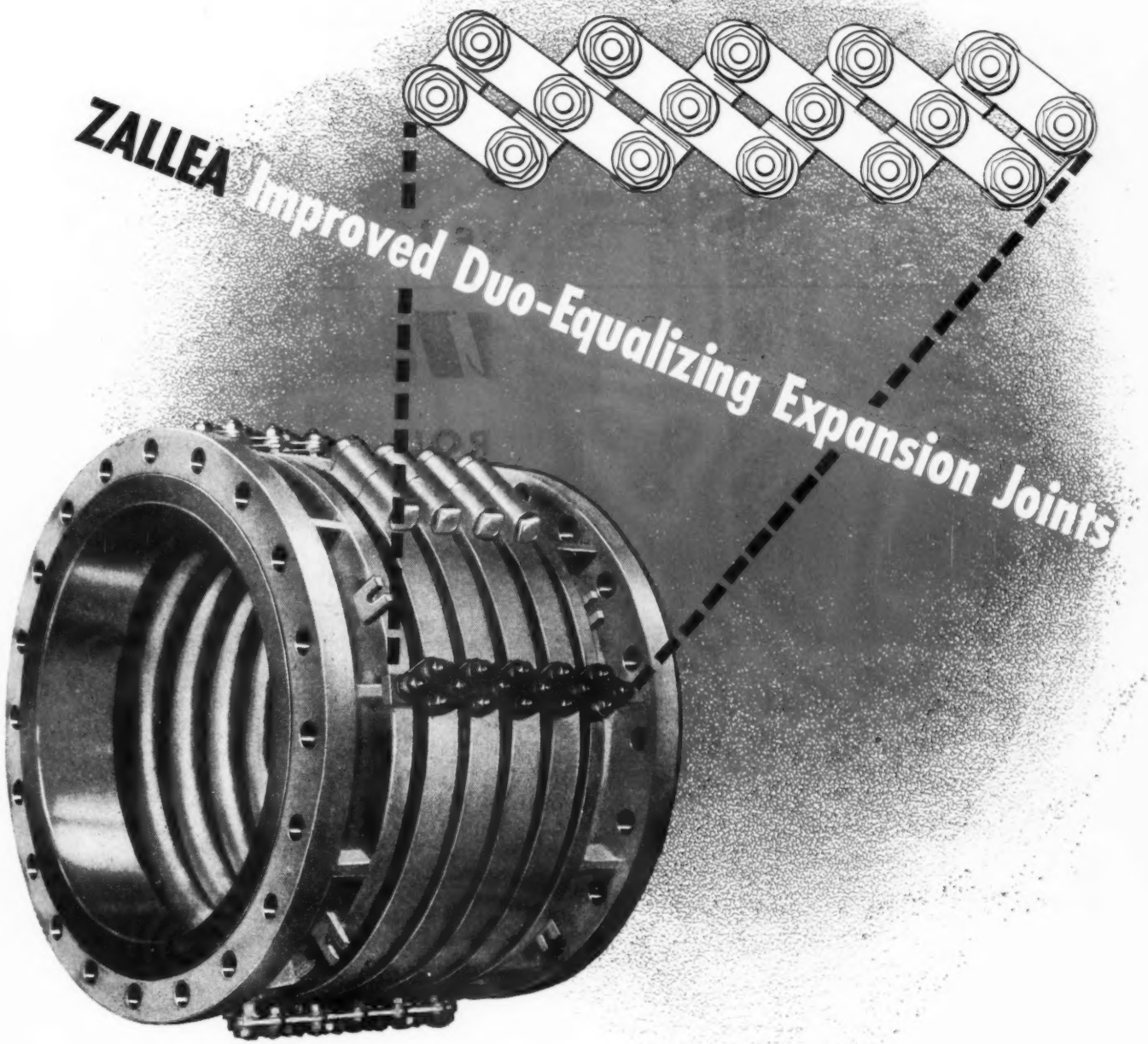
***An opportunity for the returned veteran to share in the Payroll Plan's varied benefits.***

**Your employees will require little "selling" on the idea—they are accustomed to their monthly saving habit. With the Treasury Department's savings bond program now in peacetime operation, your partnership is again invited to continue this systematic, convenient means of contribution to a prosperous peacetime future.**

*The Treasury Department acknowledges with appreciation the publication of this message by*

POWER

*This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and Advertising Council*




## . . . pantograph linkage divides every movement equally

In the new Zallea Improved Duo-equalizing* Packless Expansion Joint equal and simultaneous absorption of line movement among all corrugations is made positive by the unique pantograph chain linkage. Under contraction as well as expansion—whether the joint is absorbing its full rated traverse or only a portion of it—every movement must be divided equally.

That is why Zallea Improved Duo-equalizing Expansion Joints have longer life—why they endure in the severest service.

*U. S. Pat. Pending

*Made of copper, stainless steels and other corrosion-resistant alloys . . . Diameters from 3" upward . . . Traverses up to 7½" per single unit . . . For pressures from vacuum to 300 psi . . . For temperatures from sub-zero to 1600°F . . . Let us quote on your requirements.*

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...EQUIPMENT FOR THE PROCESS INDUSTRIES
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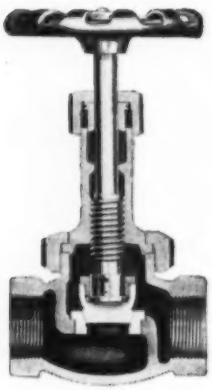
**Specify and Demand Zallea *Furnace-Annealed* Expansion Joints**

# The longest wearing bronze valve YOU CAN BUY!



## Walworth No. 225P with 500 Brinell Seats and Discs

With stainless steel seats and discs, heat treated to a hardness of 500 Brinell, this quality valve assures tight positive shut-off even after years of severe service. Boiler scale, sand, slag and similar flotage will not injure the seats and discs . . . which are hard enough to crush nails and scratch glass.

Further, No. 225P's union bonnet type construction, deep stuffing boxes, oversize stems and sturdy bronze bodies provides additional protection against wear and leakage. The valve may be repacked under pressure, when fully opened.

This exceptional valve is available in sizes from ¼" to 2", and is recommended for 350 pounds superheated steam pressure, maximum temperature 550 F, and 1000 pounds non-shock service on cold water, oil, gas or air. This valve in the angle type (No. 227P) is also available.

For full data about the Walworth No. 225P, see your nearby Walworth distributor, or write for Catalog No. 42.

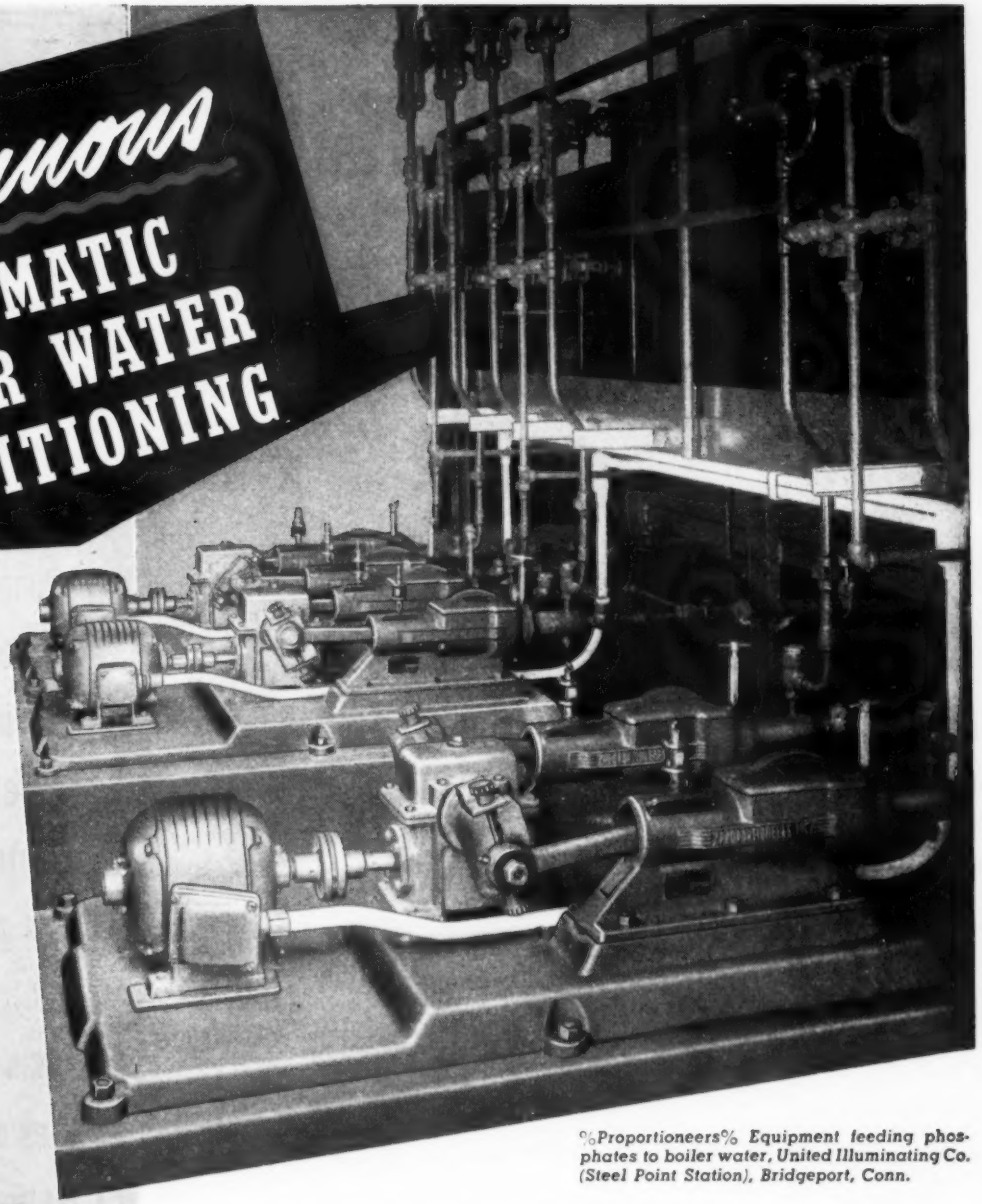
**WALWORTH**

**valves and fittings**

**60 East 42nd Street, New York 17, N. Y.**

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

# Continuous AUTOMATIC BOILER WATER CONDITIONING



%Proportioneers% Equipment feeding phosphates to boiler water, United Illuminating Co. (Steel Point Station), Bridgeport, Conn.

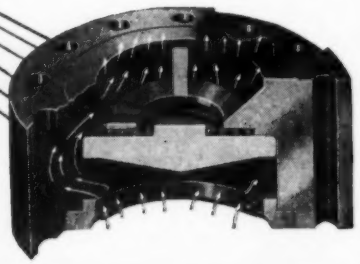
An *adequate* and *regular* method of injecting boiler water conditioning chemicals is a requisite in the modern power plant to prolong the life of its equipment, operate boilers at top efficiency with minimum fuel and avoid costly shutdowns for repairs and cleaning. The %Proportioneers% system adds the *proper* treating chemical, in the *correct* proportion at the *right* time.

Make use of the experience of America's leading chemical feeding engineers and proportioning specialists, gained in over 20,000 installations. Send details today for the complete analysis of your specific problem.

## % PROPORTIONEERS, INC. %

**Write %Proportioneers, Inc.%, 16 Codding St., Providence 1, Rhode Island.**
**Technical service representatives in principal cities of the United States, Canada and Mexico.**

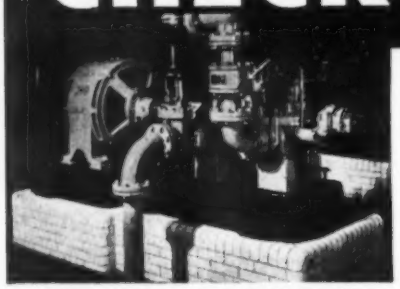
THIS NEW INFORMATIVE CATALOG WILL SOLVE YOUR "WATER HAMMER" *Problem!*



WILLIAMS-HAGER

FLANGED *Silent*

CHECK VALVES



A Williams-Hager Valve in the Metropolitan Life Building, New York.

- *Precision Engineered*
- *Economical*
- *Efficient*
- *Frictionless*
- *Tight Under Every Operating Condition or Pressure up to 6000 Lbs.*

Williams-Hager Flanged Silent Check Valves completely eliminate "Hammer" and "Bang" in the lines, provide uninterrupted constant flow of liquids.

Unlimited in size or application, from 1" to 20", built of materials to best suit the end use, Williams-Hager Flanged Silent Check Valves have been chosen for years as standard equipment in such exacting line uses as oil, gasoline, acids, water, chemicals, gas, air, salt water, brine, etc., regardless of temperature.

***Write today for YOUR copy!***

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Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

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Valves, Piping and Fittings
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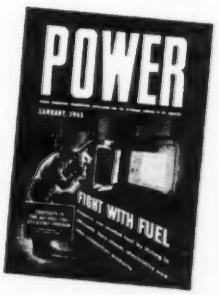


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*Covering the Generation, Transmission and Application of ALL the Power Services*

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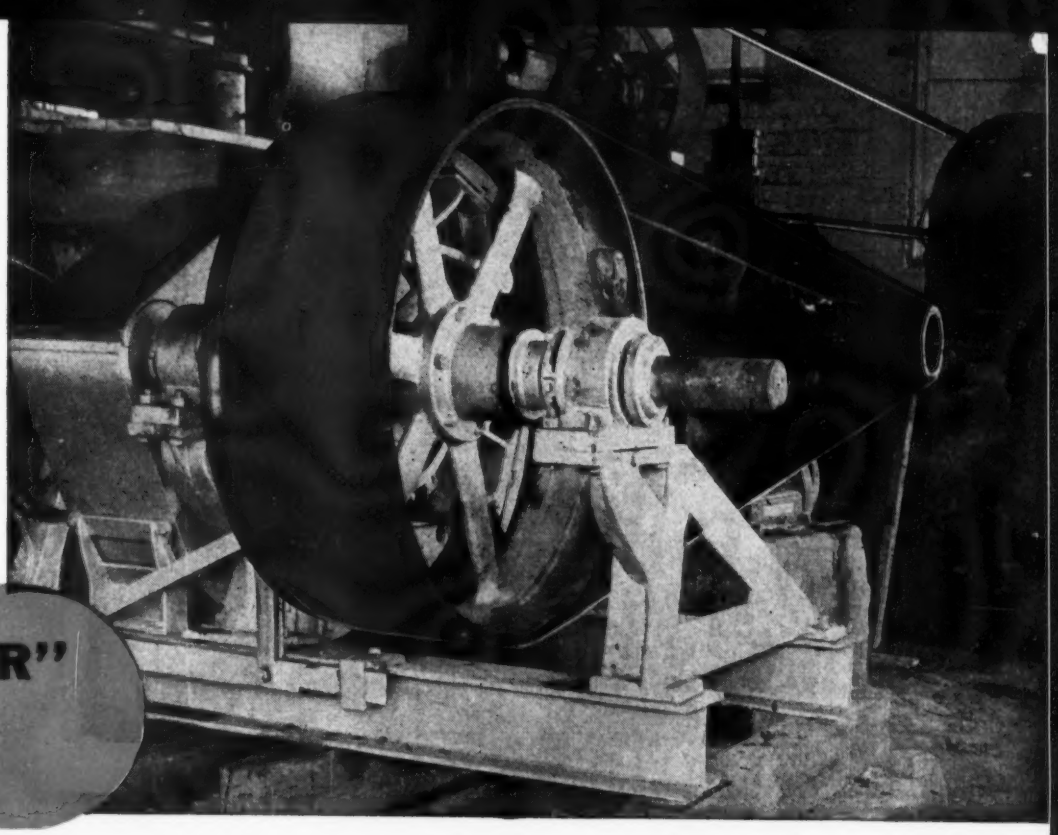
EXTENSIBLE-TIP rounding main pulley on a pug mill drive. Note series of welded Flexlastics rivets and Patent number above, molded on all Manhattan Endless Belts with Extensible-Tip for your purchasing protection.



# You get a ELECTION 4

## RENGTH MEMBER" DEVELOPMENTS

# MANHATTAN

## ENDLESS BELTS

RD ENDLESS BELT—cross section how Flexlastics are forced into ngth Member, affording complete n against atmospheric conditions.

R-WELDED 18", 8-ply Compensated Belt driving mine fan. One of the early field spliced end-smission belts, this Manhattan installation has ning without a stop 24 hours a day, 7 days a r 92 months! It wasn't even stopped for this At ordinary 8-hr. day, 5-day week schedule, rd equals about 30 years' service!

Manhattan is the only manufacturer that makes Endless Belts with *all* of the Strength Member developments described below:

**WHIPCORD ENDLESS**—Pioneered by Manhattan, featuring Strength Member of a single Flexlastics encased cord wound continuously around in the exact length of your drive. One continuous cord wound to desired width in closely laid parallels with reinforcing cover folded completely around. Embodying no Strength Member splices, Whipcord Endless becomes the smoothest pulling, longest wearing belt—at slow or high speed—on all types of pulleys—on long and short centers. Length is accurately controlled in manufacture. Practically no shrinkage or stretch.

**CONTINUOUS-WOUND DUCK PLY BELT**—Another Manhattan development. One long strip of frictioned duck of specified width is wound ply over ply in exact length until desired number of plies is reached. The duck ends are then sealed with the Extensible-Tip.

**CONDOR-WELD**—Developed by Manhattan belting engineers who are credited with being the first to successfully splice transmission belts endless on machines in the field where factory-made endless cannot be applied. The Extensible-Tip splice is an important feature of Condor-Weld. See illustration for typical record of one of Manhattan's early field splices.

**EXTENSIBLE-TIP**—Applicable to Whipcord and Continuous Wound Duck Ply belts—originated by Manhattan and protected by patent. Eliminates endless belt cover splice failures by a unique method of relieving outer-ply splice stress when passing over the pulley. The Extensible-Tip flexes around pulleys without effort or fatigue, or tendency to separate. Used on all Manhattan Endless Belts, this development has added greatly to the outstanding success of Manhattan Endless Belts.

*The term FLEXLASTICS is an exclusive MANHATTAN trade mark. Only MANHATTAN may make FLEXLASTICS.*

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MANHATTAN RUBBER DIVISION

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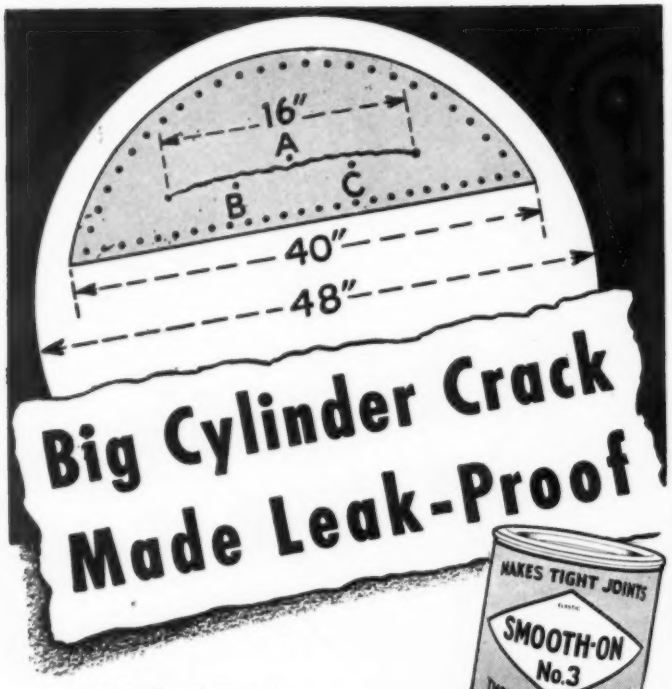


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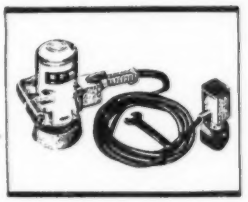
The Gaston Grinder starts at full speed. Its speed remains constant regardless of extra pressure by the operator. This controlled speed under heavy load, eliminates glazing of the grinding wheel; produces a better ground surface.



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*You can get complete information from William H. Howland, 2533 East 73rd Street, Chicago 49, Illinois*

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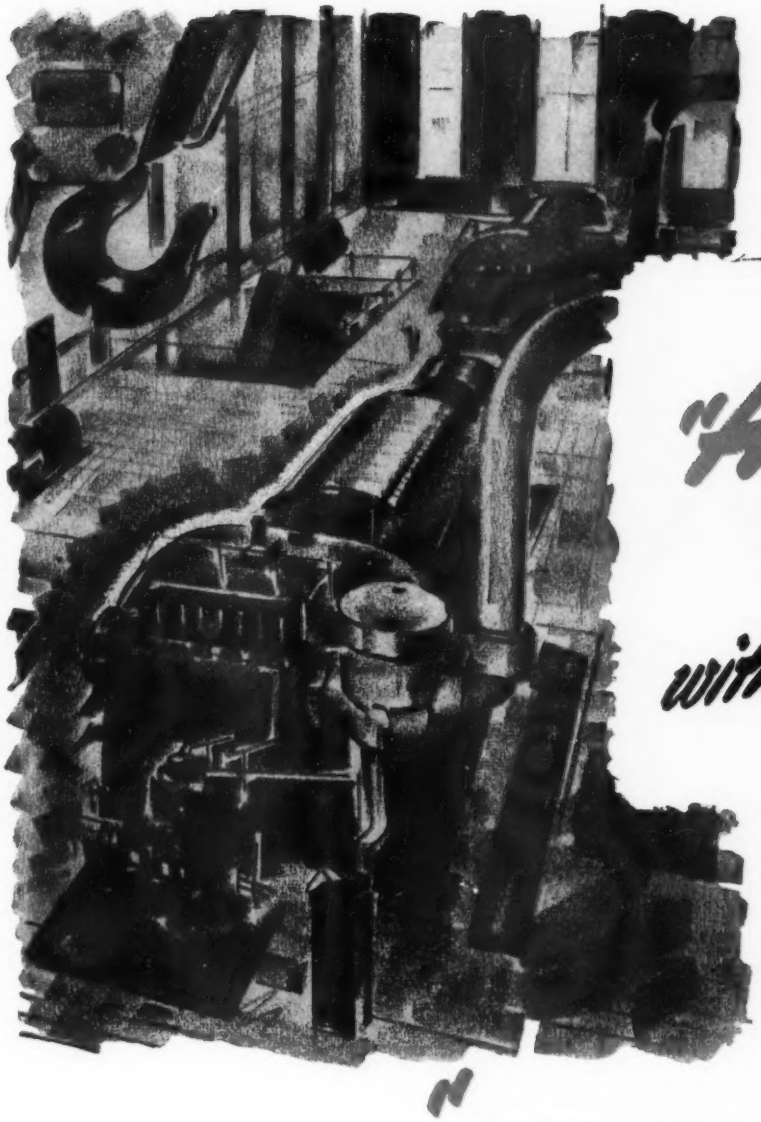

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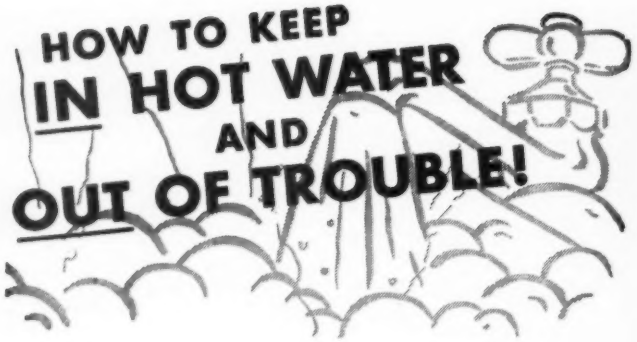

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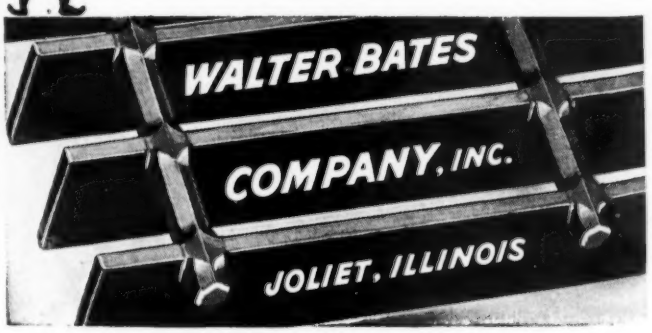

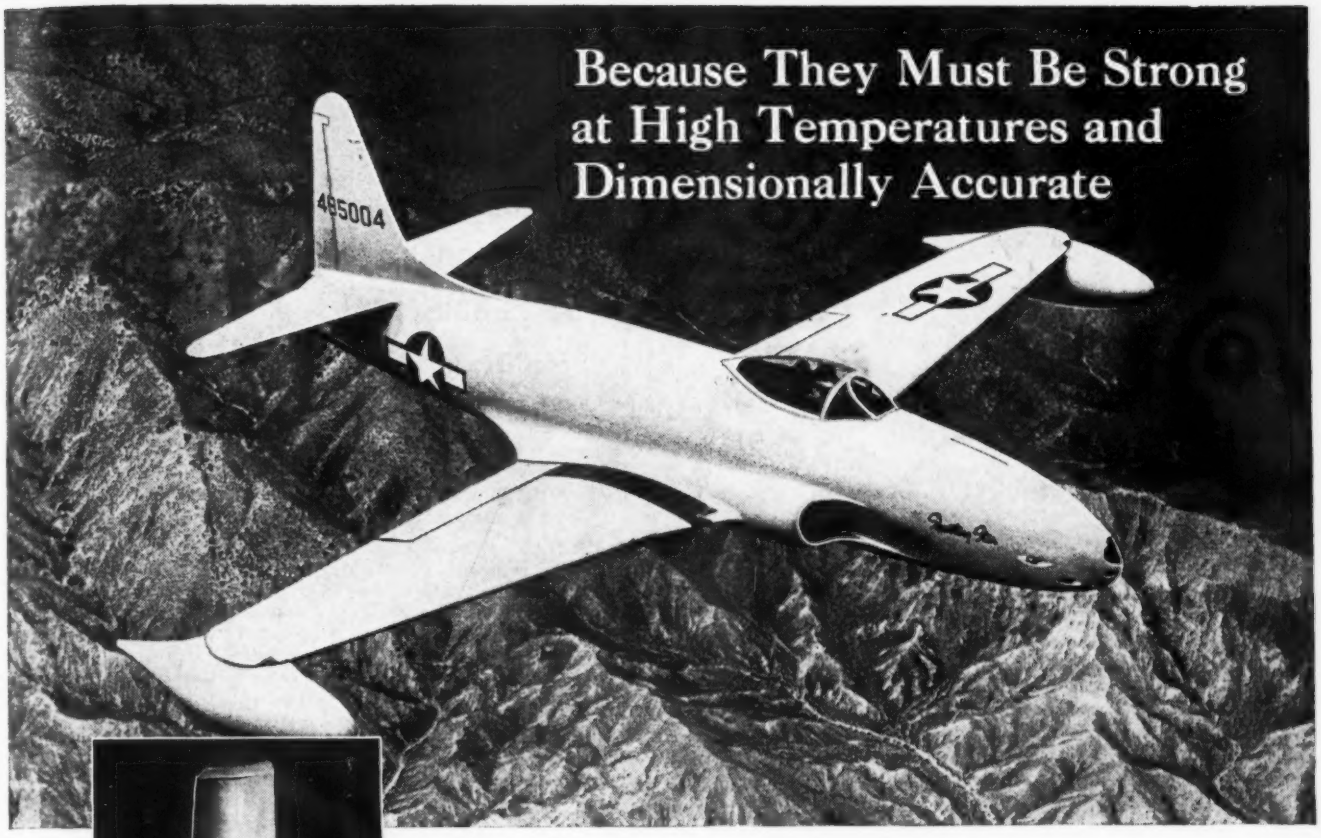


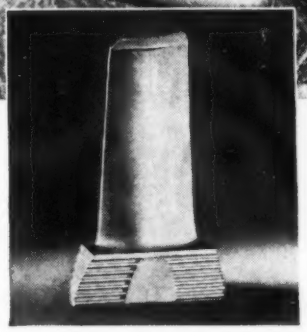

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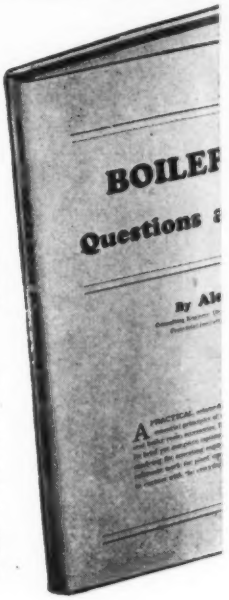


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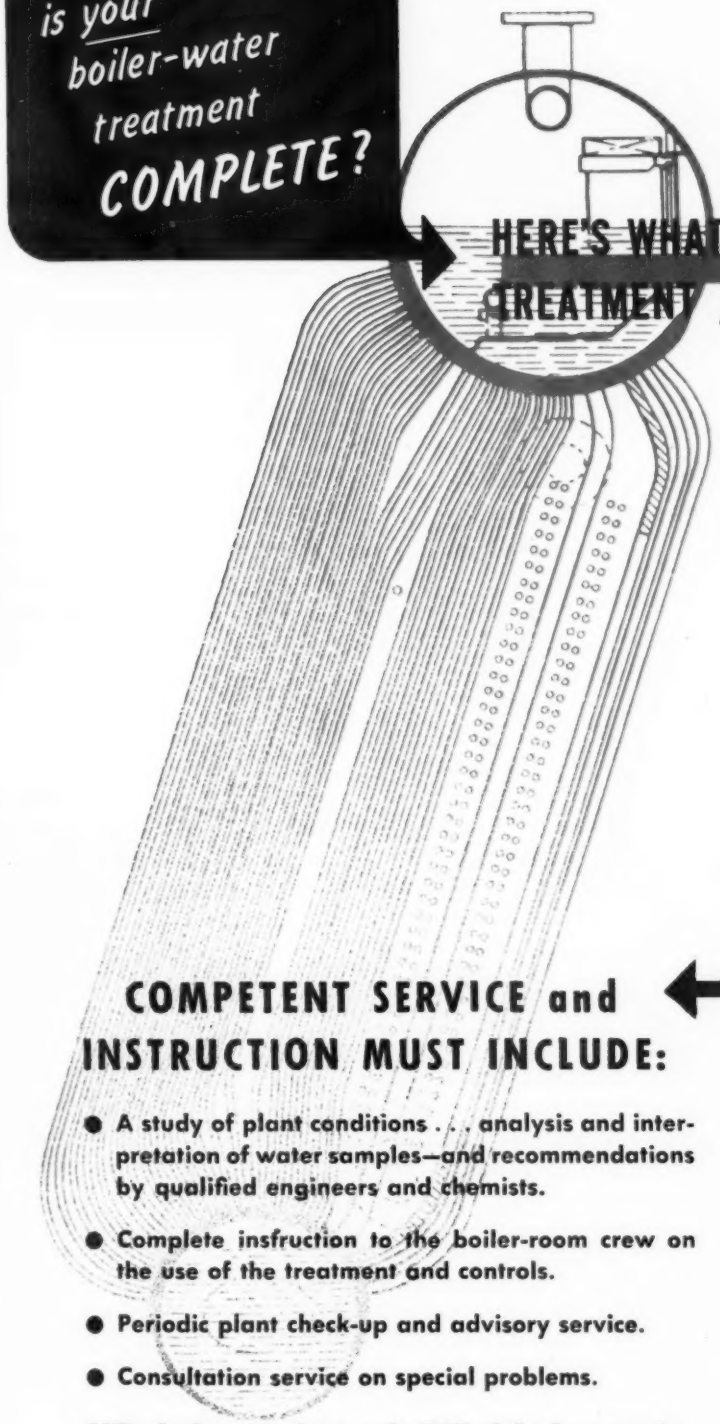

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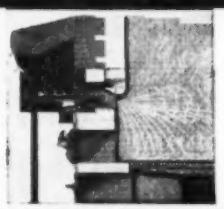

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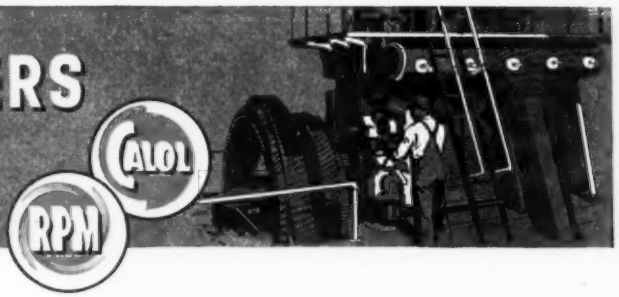


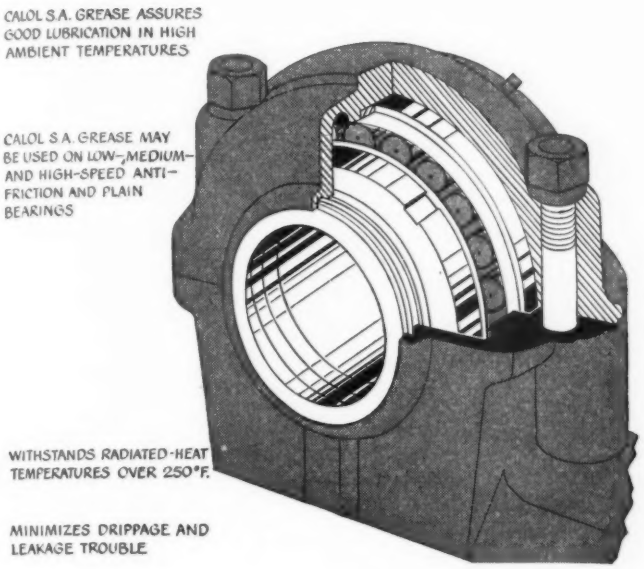
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CALOL S.A. GREASE MAY BE USED ON LOW-, MEDIUM- AND HIGH-SPEED ANTI-FRICTION AND PLAIN BEARINGS
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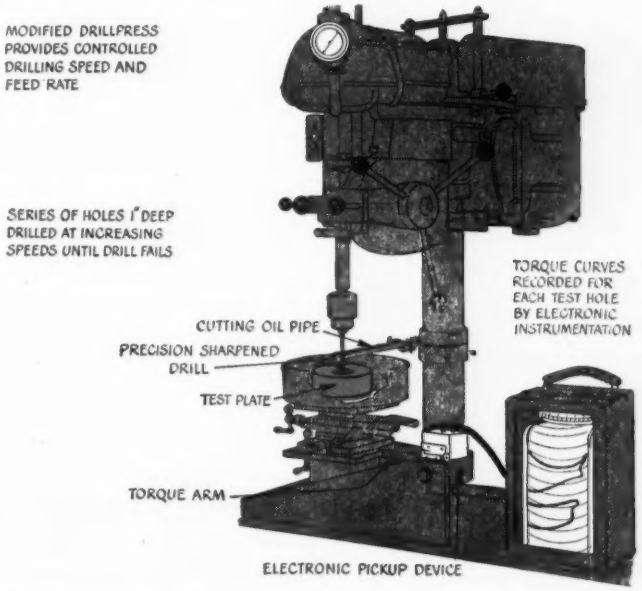
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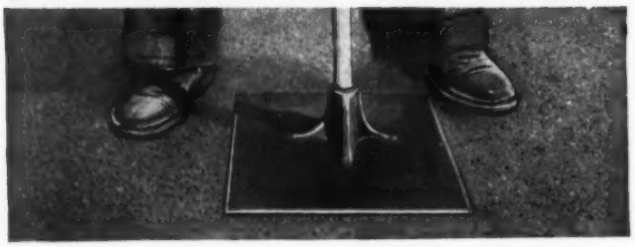

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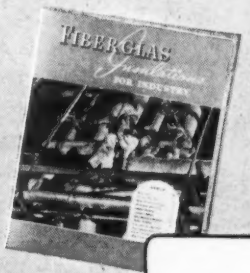


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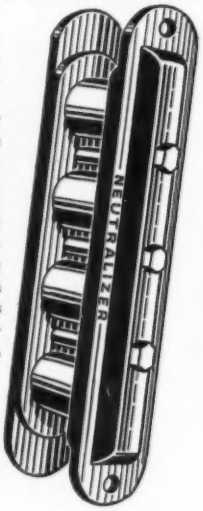
**Other FIBERGLAS Products: FIBERGLAS ELECTRICAL INSULATIONS • FIBERGLAS "DUST-STOP" AIR FILTERS • FIBERGLAS for PLASTICS REINFORCEMENT**

## CASE Histories: Boiler Maintenance

*"All Scale On Tubes And Shell Washed Free"*

"Our boiler had quantities of scale on all boiler tubes and the inside of the boiler shell," wrote C. R. Giese, Gen. Mgr., Rogers Galvanizing Co., Tulsa. "On June 25 the boiler was opened for inspection by the representative of the Hartford Boiler Insurance Co. All scale accumulated on the tubes and shell was found to have loosened and was washed free at that time. We highly recommend the Electro-Neutralizer" and so do thousands of other users. Sold by leading Supply Jobbers nation wide, or write for literature and recommendations without obligation. The Electro Chemical Engineering Co., Louisville 2, Ky.




Aids in control of pH value of water. Removes old scale, lengthens boiler life, increases steam efficiency, reduces repair cost. Makes for lower fuel consumption. Reduces the eating of metal, pitting, foaming, carry-over and all types of corrosion, including electrolytic action. Produces mineral-free water and purer steam, helps to prevent new scale formation.

**ELECTRO CHEMICAL ENGINEERING CO., LOUISVILLE 2, KY.**

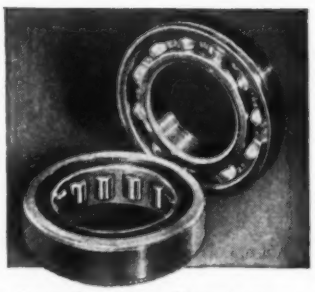
**ELECTRO-NEUTRALIZER**

FOR WATER CORRECTION AND POSITIVE BOILER-SCALE ELIMINATION



# BALL BEARING LUBRIPLATE

**FOR ALL TYPES OF ANTI-FRICTION BEARINGS**



BALL BEARING LUBRIPLATE is a single grease type lubricant developed for general use on roller, ball and plain sleeve bearings operating at speeds up to 5000 RPM and at temperatures up to 300° F. Its performance is outstanding. BALL BEARING LUBRIPLATE not only does a better lubrication job, but it definitely gives protection against the arch enemy of bearings . . . corrosion. Increase the life of your bearings with LUBRIPLATE.

*. . . Write for a booklet, "The LUBRIPLATE Film" written especially for your industry.*

**LUBRIPLATE**

FISKE BROTHERS REFINING CO.

NEWARK 5, N. J.
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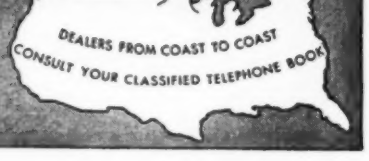


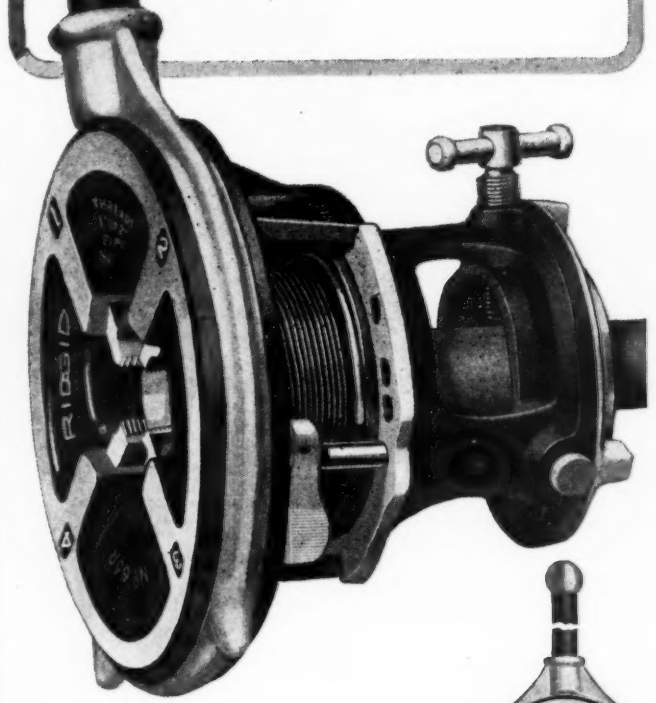



**You get perfect pipe threads more easily with this**

***Self-contained Semi-automatic***

**RIDGID**

**No. 65R Threader**



*It stands up handily on the floor.*

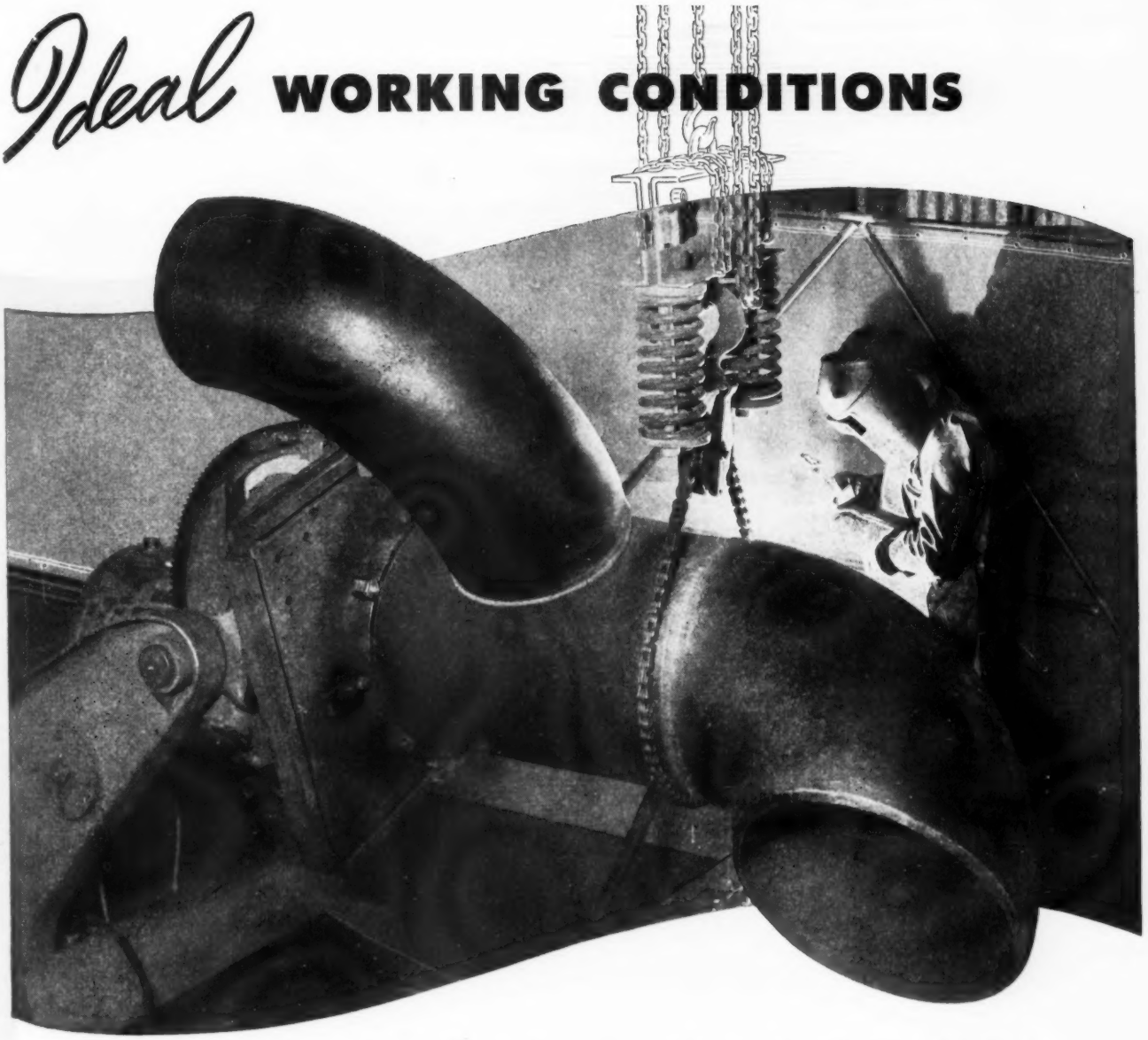
● This modern threader is always ready to cut perfect threads on 1", 1¼", 1½" or 2" pipe. One set of chasers that stay in the die stock adjust to size in 10 seconds—workholder sets instantly, no bushings. Precision-made in all 23 of its rugged steel-and-malleable parts, it gives you micrometer perfect threads with least possible effort—and quickly. To cut smooth threads more easily—ask your Supply House for the efficient RIDGID No. 65R.

★ RIDGID ★

**WORK-SAVER PIPE TOOLS**

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

# *Ideal* WORKING CONDITIONS



## . . . *Another Reason for the Superiority of Modern* SHOP FABRICATION

DIFFICULT fabrication that cannot be done efficiently in the field is handled easily in the completely equipped Pittsburgh Piping plant. For example, shop equipment such as that illustrated, enables the welder to work in a down-hand position on circumferential welds. Each weld is inspected, and laboratory facilities are utilized as required to analyze welding specimens.

Quality—the important factor in the safe performance of any installation—is assured when piping is pre-fabricated in the shops of Pittsburgh Piping and Equipment Company.

The advantages of shop fabrication—extended experience, specialized engineering help, every facility for bending, Van Stoning, machining, heat-treating, stress-relieving, pressure-testing—assure an infinitely better piping job.

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AND EQUIPMENT COMPANY

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FOR GAUGING LIQUIDS OF ALL KINDS

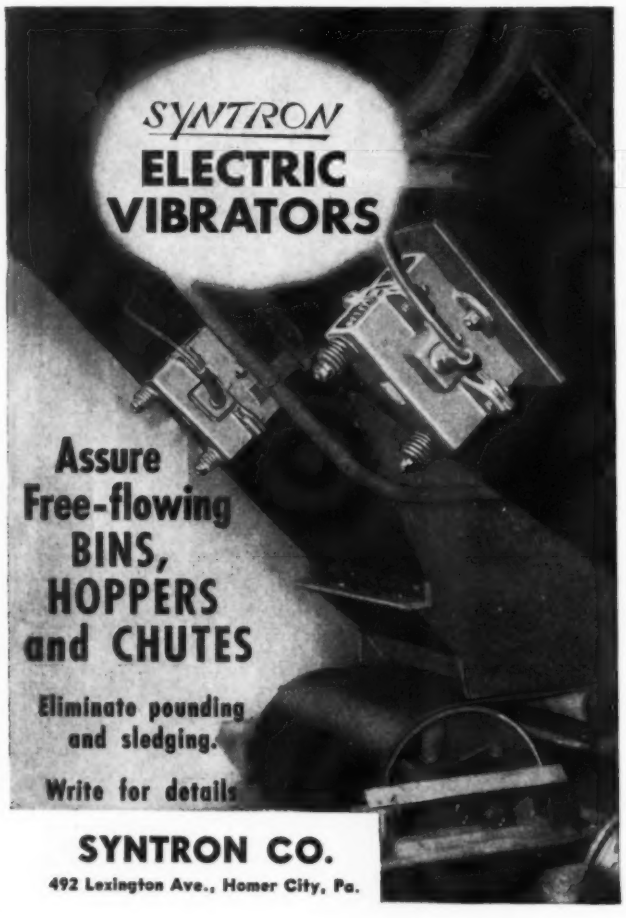
APPROVED BY UNDERWRITERS' LABORATORIES

WRITE for COMPLETE DETAILS

"LIQUIDS WORTH STORING ARE WORTH MEASURING"

THE LIQUIDOMETER CORP.
39-16 SKILLMAN AVE., LONG ISLAND CITY, N.Y.






SYNTRON CO.
492 Lexington Ave., Homer City, Pa.



*"Why Don't You Advertise Yourself"*

## Says a Power Advertiser

McGraw Hill Publishing Company
330 West 42nd Street
New York City,

ATT'N: Mr. Weidig.

Dear Mr. Weidig:

Referring back to the success we had in our last year's advertising in Power you will recall that through this medium we recently sold a four unit Buckeye Diesel Generating plant to a customer in Massachusetts. This sale amounted to about $52,000.00.

Well you've done it again —

In your July issue of Power you carried a full page ad showing the Diesel Plant formerly the property of Simonds Saw & Steel Company of Fitchburg, Massachusetts, again through the medium of Power our name was brought to the attention of a Vermont Manufacturer to whom we have just sold one of the Simonds Saw units. This sale amounted to something over $17,000.00.

Why don't you do a little advertising in Power yourselves using this letter if you care to.

Sincerely,
ROBERT SCHOONMAKER.

**• In the power field, POWER has been the marketplace for more than 60 years. It draws power engineers all over the world together into a commercially accessible group. Alert editing has drawn an average of an award a year, but more than that, it has drawn more than 28,500 interested subscribers. Mr. Schoonmaker's experiences are not unique among POWER advertisers, for more advertisers use POWER than any other publication in its field. POWER receives half of every dollar spent for power-field advertising, has more exclusive space than all other publications in its field put together, and is the choice of agencies for exclusive accounts eight times out of ten.**

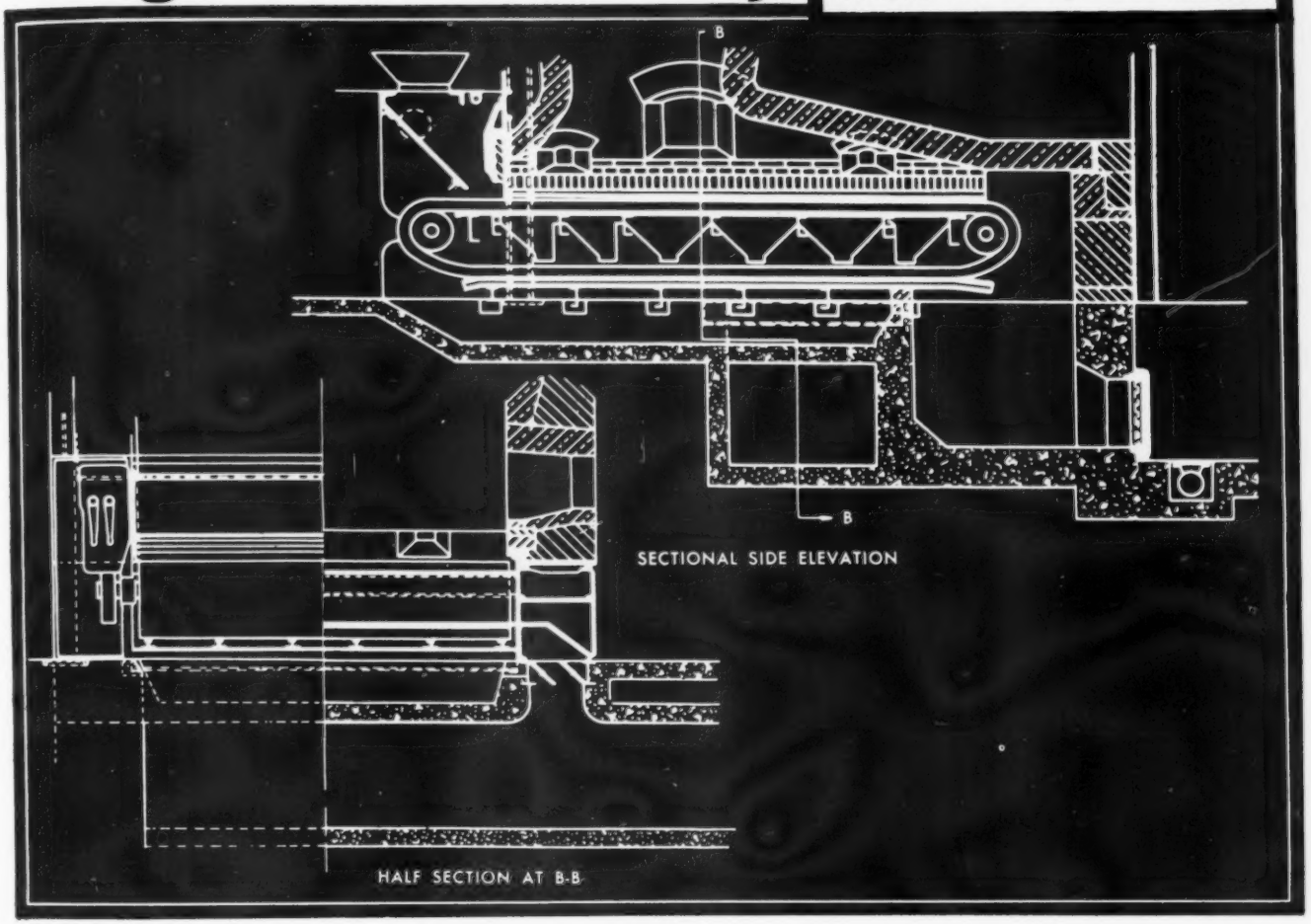
ABC **POWER** ABP

The Market place of the Power Field for 60 years

# Designed for Efficiency

**WALL BRICK DATA**

**McCLAVE Forced Draft Chain Grate STOKER**




In terms of more steam at less cost, this installation of a CARBOFRAX silicon carbide brick setting with a McClave Stoker clearly illustrates sound engineering. Although varying operating conditions determine coverage height of lining—increased furnace efficiency is a foregone conclusion.

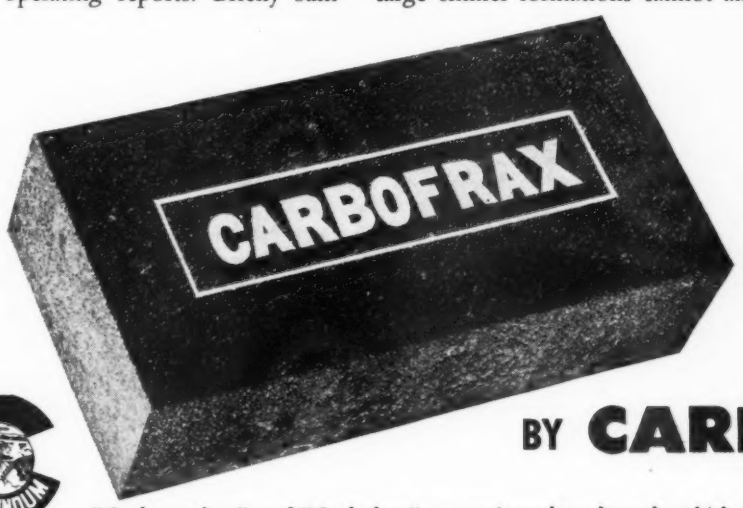
Statements such as these are not unfounded claims. They are supported by actual operating reports. Briefly summarized, they echo confirmations of:

**Greater steaming capacity**
**Improved combustion conditions**
**Longer periods of continuous operation**
**Lower labor and refractories costs**

All these advantages result directly from the super refractory properties of CARBOFRAX brick. There is no softening at high temperatures. Hence, large clinker formations cannot anchor or build out on the surface. The moving fuel bed tends to keep walls clean thereby lessening the frequency and difficulty of barring. The entire grate area is more effectively utilized . . . a more active fire maintained . . . fuel combustion improved and cost cut.

Of equal importance is the exceptional strength and resistance to mechanical and flame abrasion of CARBOFRAX brick. They do not wear or cut back. 8 to 10 years service is not exceptional. Outages for lining repairs are rare. Dependable on-line service is consistent.

Then, too, there are other benefits that make themselves known in improved operating reports. A factual, illustrated, technical booklet "CARBOFRAX in Boiler Furnaces" tells the complete story. For more specific information pertinent to your own furnaces, we will gladly cooperate. In either case, don't put off writing Dept. G-56, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.




**BY CARBORUNDUM**
TRADE MARK

*"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company*

# This Tag Talks

Should you ever require replacement parts for your CASH·ACME Type "B" just mention the Number on this tag. It will tell us the Pipe Size, Type of Service, and all other Data necessary to enable us to quickly and efficiently fill your order. This is but one of the many features incorporated into the TYPE "B".

*Write today for your copy of our 28 page Catalog showing in detail how this and other CASH·ACME products can best serve you.*

*An Automatic* VALVES *as* THIS *name that counts*

CASH·ACME

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**INQUIRIES WELCOMED . . .**

We welcome your inquiry on any Steel Plate Fabrication problem. Simply call or write NSF today. No obligation whatsoever. Write for Descriptive Folder.

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*Fabricators, Inc.*

NAZARETH, PA

STEEL PLATE CONSTRUCTION..ENGINEERING..

LIGHT STRUCTURAL STEEL..SCREW CONVEYORS

## *Prevent Motor* BREAKDOWNS *that cause Plant* SHUTDOWNS!

# IDEAL MOTOR MAINTENANCE EQUIPMENT

***New motors are still scarce; conserve the ones you have.***

When Commutators and Slip Rings show signs of wear, when spitting and burning indicate high mica, etc., a few minutes use of IDEAL Motor Maintenance Equipment will restore original high efficiency. IDEAL Tools used periodically keep Commutators and Slip Rings "good as new" and prevent costly shutdowns.

**1 RESURFACERS** (Hand Type) Remove pin ridges, roughness and small flat spots from Commutators and Slip Rings, while the armature rotates in its own bearings.

**2 PRECISION GRINDERS** (with Tool Type Resurfacers) Restore surfaces that are badly scored and out-of-round. Easy to mount right on motor frame. No dismantling necessary.

**3 MICA UNDERCUTTERS** (Power Driven) Undercut hardest mica, without taking down motor or generator.

**OTHER** IDEAL Motor Maintenance Equipment—Carbon Brush Seater, Commutator Cleaning Stone, Commutator Saws and Milling Cutters, Slotting Files, Hand Type Slotter and Scraper, etc.

Motor Equipment Division

**IDEAL INDUSTRIES, Inc.** *(Successor to Ideal Commutator Dresser Co.)*

1025 PARK AVENUE SYCAMORE, ILLINOIS

1753

**TEMPERATURE SELECTOR PANEL**

# *Matches*

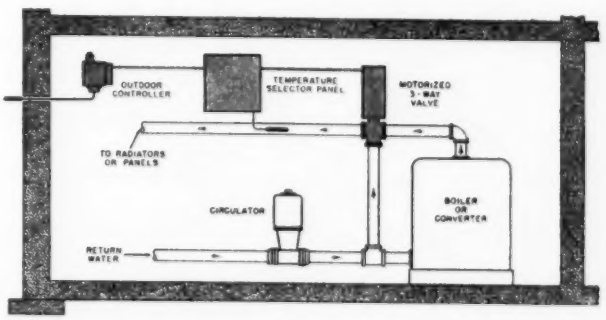
# HOT WATER BOILER CAPACITY

# TO *Outdoor Weather!*

Here's how you can apply the principles of the new Honeywell Moduflow system to commercial hot water heating.

The Honeywell Temperature Selector Panel enables you to match the capacity of the hot water system to outdoor weather. It enables the system to directly follow the changes in weather conditions. This not only saves fuel, but provides more even, healthful heat. Temperature of the supply water is modulated to a higher degree when outside temperature falls—to a lower degree when milder weather occurs. Wasteful, uncomfortable heating during moderate weather is overcome. And quick response of the heating system is assured in severe weather.

The equipment can be applied to new or existing heating plants. It is adaptable to all types of hot water heating and to all kinds of automatic burners, and is available for single or multiple zone applications. If you have not already investigated this new system, write at once for complete information. Minneapolis-Honeywell Regulator Co., 2607 Fourth Ave. South, Minneapolis 8, Minnesota. Branches and distributing offices in all principal cities.




**System hook-up for commercial hot water plants. Boiler capacity is controlled to match varying outdoor weather.**

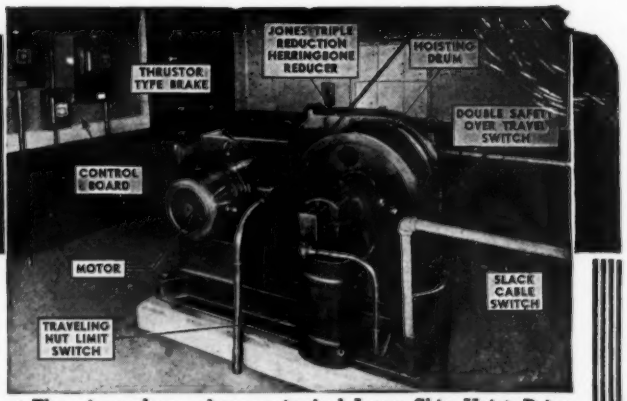
*IT'S THE PRODUCT BEHIND THE NAME THAT COUNTS*

MINNEAPOLIS **Honeywell**

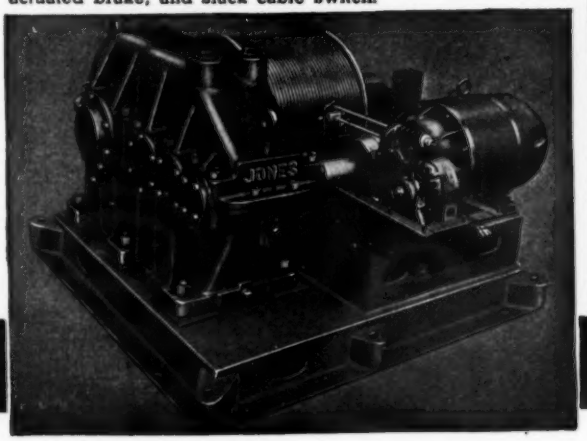
CONTROL SYSTEMS

*For Economical Material Handling*

# JONES SKIP HOIST DRIVES




• The view above shows a typical Jones Skip Hoist Drive installation while the view below shows one of the Jones units equipped with traveling nut type limit switch, motor actuated brake, and slack cable switch.



FOR speedy operation, reliable service and over-all economy the Jones Skip Hoist Drive has made a name for itself in a wide variety of material handling service. These skip hoist drives are built as complete units by the Jones organization in several types with base to take any motor specified by the purchaser. They are equipped for all the modern protective devices such as cam or nut type limit switches, solenoid or disc type brakes and slack cable switches. The drives are single, double, or triple reduction Jones Herringbone Speed Reducers, built to stand up under the many years of pounding that a skip hoist drive has to take. The shafts are supported in roller bearings, with rolling action, rack generated gear and pinion teeth to insure easiest possible starting with low starting-peak loads. All reducer bearings and gears are automatic oil-bath lubricated.

The Jones organization has an extensive file of information on skip hoist drive problems and will be pleased to work with you on any problems involving such applications

**W. A. JONES FOUNDRY & MACHINE CO.**
4423 Roosevelt Road, Chicago, Illinois

**Jones** HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES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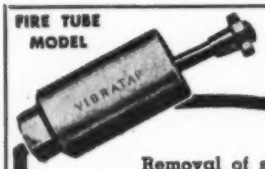
**Featuring additional products and specialties for power plants**


FIRE TUBE MODEL



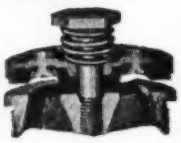

**SAVE COAL**

Removal of scale from boiler tubes always saves coal. Use a VIBRATAP TUBE CLEANER for a thorough removal of incrustation. Write for Bulletin V-20.

**BRUNT EQUIPMENT CO.**
60 S. DIVISION ST. • BUFFALO, N. Y.

*End Pump Troubles!*

**HILL IMPROVED PUMP VALVES**



• The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate. Send today for bulletin that tells how to get better pump performance.

**HILL PUMP VALVE CO.**
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ROTARY
GEAR
SHIFT
4 Models:
30-48,000 RPM
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THE POWERS REGULATOR CO.

*MAKE it your habit to check, each issue, the announcements appearing on the Where To Buy page. They supplement other advertising in Power of products and services essential to modern power plant operation.*

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Send for Bulletin

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**BOILER BAFFLES**
**HIGH TEMPERATURE**
**Refractory Cements**
SANFORD C. SMITH REFRACTORIES, INC.
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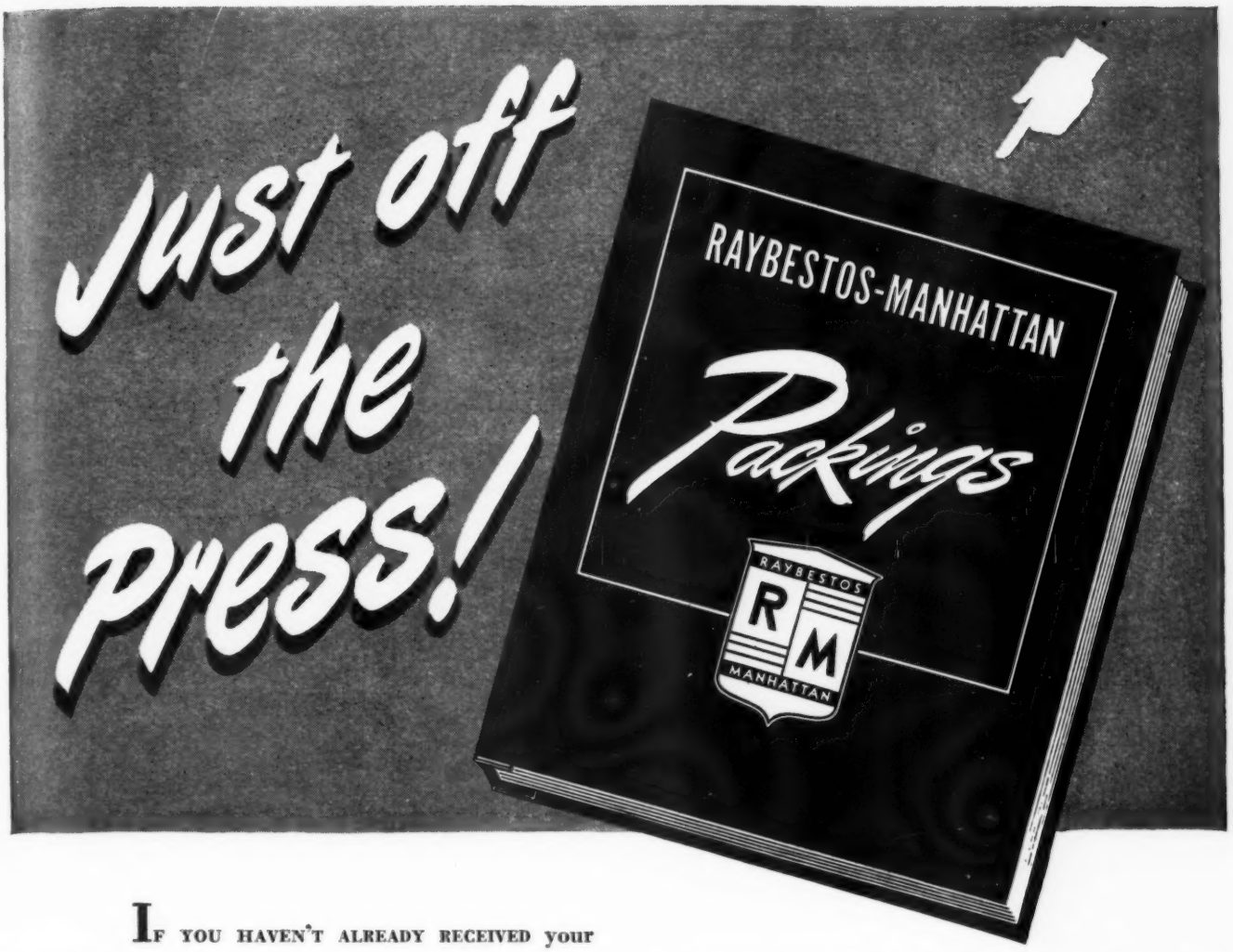


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This new edition is 72 pages . . . one of the biggest catalogs we have ever issued. It is fully illustrated, carefully indexed. It contains pictures and detailed descriptions of all of R/M's asbestos, rubber, fabric, metallic, and plastic packings and gaskets. Also engineering data and complete information on new products developed during the war years.

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Write us today, if your copy hasn't already arrived.

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**R/M packings *for maintenance* are sold exclusively through authorized distributors. This policy provides the best possible on-the-spot service, and assures you that there is an authorized distributor near you, studying your problems and stocking the packings you need.**

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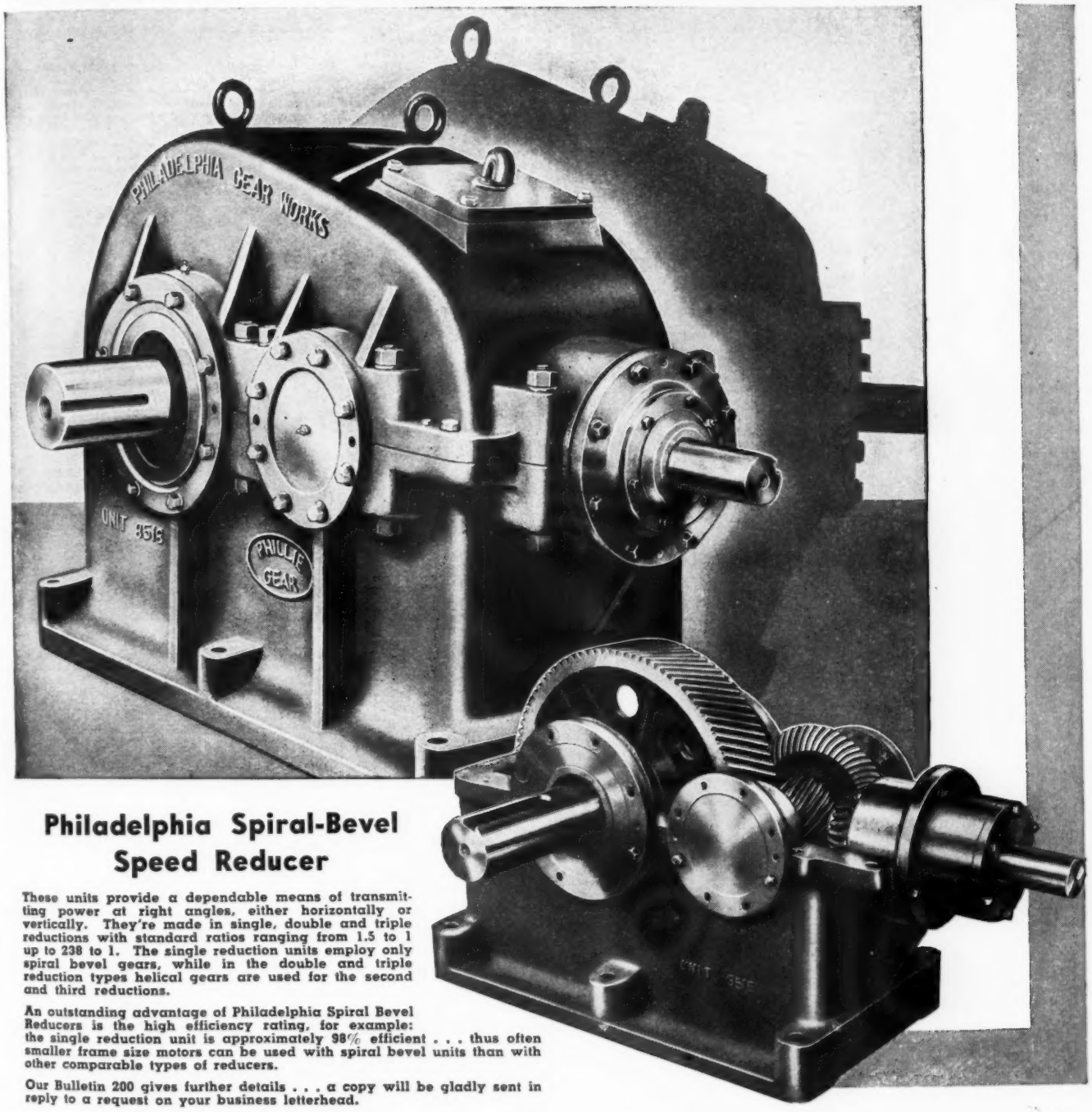
# A Right-angle drive with a VERY HIGH EFFICIENCY




## Philadelphia Spiral-Bevel Speed Reducer

These units provide a dependable means of transmitting power at right angles, either horizontally or vertically. They're made in single, double and triple reductions with standard ratios ranging from 1.5 to 1 up to 238 to 1. The single reduction units employ only spiral bevel gears, while in the double and triple reduction types helical gears are used for the second and third reductions.

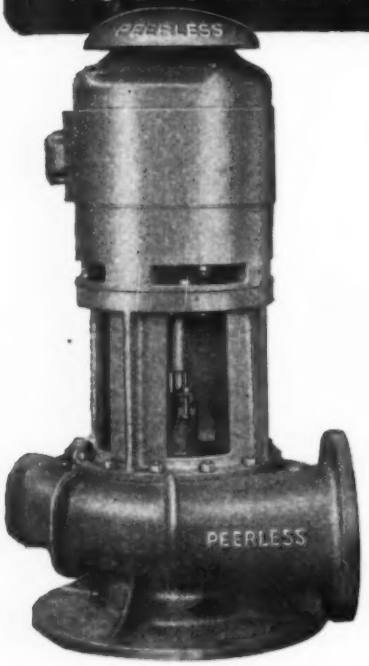
An outstanding advantage of Philadelphia Spiral Bevel Reducers is the high efficiency rating, for example: the single reduction unit is approximately 98% efficient . . . thus often smaller frame size motors can be used with spiral bevel units than with other comparable types of reducers.

Our Bulletin 200 gives further details . . . a copy will be gladly sent in reply to a request on your business letterhead.

**Philadelphia**
**GEAR WORKS INCORPORATED**
**ERIE AVE. AND G ST., PHILADELPHIA 34, PA.**
NEW YORK • PITTSBURGH • CHICAGO . . . IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

*Industrial Gears and Speed Reducers*
*LimiTorque Valve Controls*

# Peerless
## Vertical Centrifugal
# Pumps
FOR SHALLOW LIFTS




Close Coupled Type

PEERLESS UMPS

**100 to 5000 g. p. m.**

•

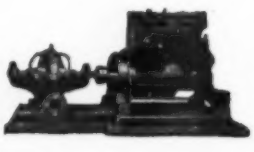
**15 to 100 foot head**

PEERLESS Vertical Centrifugal Pumps are intended for general pumping purposes.

They are built in both the Close-Coupled and Submerged types. The Submerged type is furnished with either top or bottom suction. Direct connected electric motor, steam turbine or engine drive, either direct or through right angle gear.

These pumps are successfully applied to sumps or drainage or wherever it is necessary to move large quantities of water at comparatively low lift.

Installation space is reduced to a minimum, of paramount importance in most industrial installations.

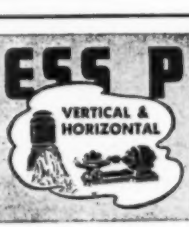


***Peerless Horizontal Pumps***

General service horizontal centrifugal pump, arranged for engine drive. Sizes: 8" to 20". Capacities: to 60,000 g. p. m. Heads: to 750 lbs.

**PEERLESS PUMPS**

PEERLESS PUMP DIVISION
Food Machinery Corp.




FACTORIES
LOS ANGELES 31, CALIFORNIA
301 West Avenue Twenty-six
QUINCY, ILL. • CANTON 6, OHIO



# Are you equipped to hold your job?—to get a new one?

**The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.**

**It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.**

**How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books?**

**Thousands of men have followed this plan to win advancement or to make their jobs safe. You can too. Read about this Library and our Free Examination Offer. Then send the attached coupon to us today.**

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**(6 volumes—2,477 pages, 2,404 illustrations)**

The Library of Power Plant Practice is the standard of the power plant field. It is accurate — it is thorough — it is complete. It is the result of years of experience with power plant problems. The man who has it has the best. The Library covers the whole field—nothing is omitted. The solution of every problem is plainly worded or explained with a clear illustration. The little stickers and the big troublesome problems are all worked out in advance for you. There can be only one result from studying these books a few minutes each day — more money in your pocket.

No books dealing with the work of the power plant man were ever so complete—so authoritative—so practical in text and illustrations as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him in language he can understand, all the information he needs in order to get ahead in his work.

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These books are written in everyday easy-to-understand language. They are written to help the man on the job. It is just as if the author were working in the plant by your side and giving you the benefit of his vast knowledge, man to man. There is no bunkum in this Library, nor is it cluttered up with impractical theories. It is a Power Plant Library FOR POWER PLANT MEN.

Glance at the titles of the books in the photograph. They will give you an idea of how completely this Library covers Power Plant Practice. Here you have all the information necessary to make you indispensable on the job.

## See it 10 days—Send no money

Fill in and mail the coupon below and we will send you the six volumes of the Power Plant Library for 10 days' examination. If you decide to keep the books after examining them, just send $3.00 and then $2.00 a month until the total low price of $16.00 has been paid. See the coupon below for details. Send it Now and HOLD THAT JOB!

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## SHIFT ELECTRICIAN

Permanent. Man under 45. Previous utility experience in Steam- Electric Generating Plant Required.

**Salary 12.16 per day**

Apply in own handwriting giving full particulars including education, physical condition, and detailed account of experience. Enclose Snapshot.

**PERSONNEL DEPARTMENT**
**San Diego Gas & Electric Company**
831 6th Ave. San Diego, California

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WANTED

## MECHANICAL ENGINEER
### FOR STEAM POWER PLANT DESIGN

An unusual opportunity for a young engineer well grounded in steam power plant design to join a growing organization

**WESTCOTT & MAPES, INC.**
NEW HAVEN, CONNECTICUT

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## WANTED

Position of assistant power plant superintendent open in large woodworking plant near Chicago. Requires good working knowledge of steam and electricity generation, power plant maintenance, water softening and experience in power plant supervision.

Give all pertinent information in first letter. All inquiries will be held confidential.

**The Singer Manufacturing Co.**
2115 Western Avenue
South Bend, Indiana

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WANTED

## ELECTRICAL ENGINEER

For Power Plant Design
Must have Public Utility Experience

**WESTCOTT & MAPES, INC.**
New Haven, Connecticut

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Experienced watch engineers and firemen for new steam electric generating station. Must be familiar with pulverized fuel. Plant located at Beloit, Wisconsin. Write to

**PERSONNEL DEPARTMENT**
**WISCONSIN POWER AND LIGHT COMPANY**
Madison, Wisconsin

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**Selling and Business opportunity Advertisements on page 312**

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# SEARCHLIGHT SECTION

*(Classified Advertising)*

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15 CENTS A WORD, MINIMUM CHARGE $3.00
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NEW ADVERTISEMENTS received by May 1st will appear in the June issue, subject to limitations of space available. P

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## MECHANICAL ENGINEERS

Large engineering and construction organization desires Mechanical Engineers with substantial experience in design and engineering of steam power plants. Applicants state experience, education, age and salary. Write

P-128, Power
330 West 42nd St., New York 18, N. Y.

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LARGE INDUSTRIAL Concern has opening for graduate engineer under 36 years of age who is experienced in Construction & Mechical Engineering. Excellent opportunity for right man to advance. Must be willing to travel and supervise construction and machinery installation at various company properties. Give qualifications, experience and photo. All communications will be answered and held in confidence. P-132, Power, 330 W. 42nd St., New York 18, N. Y.

ASSISTANT MAINTENANCE: Engineer. Mechanical engineering graduate, experienced in handling labor and maintenance work, chemical plant process equipment, and power department. P-133, Power, 520 N. Michigan Ave., Chicago 11, Ill.

POWER PLANT Engineering and construction company located in midwestern city have an opening for a competent power plant engineer having specific experience with high pressure piping design and detailing and with general power plant construction practice. Excellent opportunity for competent man who is willing to apply himself. Man should preferably be technical graduate with specific experience in this field. Good salary will be paid. Employment permanent. Please send detailed description of education and experience. Expenses for personal interview will be paid. P-134, Power, 520 N. Michigan Ave., Chicago 11, Ill.

### EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of 36 years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

### POSITIONS WANTED

EMPLOYMENT OFFICER with gas and electric company desires position as personnel director or labor relations officer. Utility preferred. Qualifications: Ex-Naval Lieutenant, age 34. With present employer since 1937. Good background in steam-electric generating station and personnel administration. Special training in electronics, diesel, and personnel administration including interviewing, counselling for employment, labor relations, and examining and testing techniques. Desire change to better my position. PW-135, 621 So. Hope St., Los Angeles 14, Calif.

ELECTRICAL AND Mechanical Engineer: 43, graduate, trained internationally known manufacturer. 20 years experience including industrial and utility power plant construction, operation; transmission, distribution design, construction, operation; industrial plant electrical design. 10 years foreign service (6 in oil refineries, oilfields). Executive and organizing ability. Good references. Wishes responsible foreign assignment. Available short notice. PW-136, Power, 330 W. 42nd St., New York 18, N. Y.

(Continued on page 312)

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### MECHANICAL
### ELECTRICAL

We have several openings in our East Chicago, Indiana refinery for qualified designing draftsmen. An engineering college degree is desirable but not necessary for men having good practical experience.

*Structural* — Design industrial buildings—miscellaneous structures of steel and reinforced concrete.

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*Apply to:*

**R. D. Clark, Personnel Dept.**

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Phone East Chicago 924, Ext. 6

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## STRUCTURAL ENGINEER
### FOR DESIGN OF STRUCTURAL STEEL AND REINFORCED CONCRETE STRUCTURES

An unusual opportunity for a young man experienced in the design of structural steel and reinforced concrete to join a growing organization.

**WESTCOTT & MAPES, INC.**
NEW HAVEN, CONNECTICUT

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WANTED

### POWER PLANT SUPERINTENDENT

Power plant superintendent under 45 years of age, experienced in high-pressure plant operation, maintenance, and labor relations. Permanent connection, company in middle-west, residence in middle-size industrial community, salary $6,000. Write education, experience, references.

P-125, Power
520 North Michigan Ave., Chicago 11, Ill.

# SEARCHLIGHT SECTION

(Continued from page 311)

## SELLING OPPORTUNITY WANTED

POWER ENGINEER: with numerous important contacts and experienced with plant operation and maintenance, wants connection with well known plant equipment manufacturer, as sales or service representative. Desired location Southwest. RA-137, Power, 520 N. Michigan Ave., Chicago 11, Ill.

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INDUSTRIAL CHEMIST with thirteen years experience desires to purchase going water treatment business. Will consider partnership. BO-122, Power, 330 W. 42nd St., New York 18, N. Y.

**Wanted**

**ADDITIONAL LINE**

Connecticut Engineering Sales Organization operating over twenty years seeks additional line power plant and factory equipment.

RA-127, Power
330 West 42nd St., New York 18, N. Y.

**NEW YORK REPRESENTATION**

Engineering Sales Organization more than 15 years Successful Experience wishes to handle Account of Power Plant—Process or Heat Exchange Equipment on Commission Basis. Can offer Concentrated Metropolitan and Vicinity Coverage.

RA-131, Power
330 West 42nd St., New York 18, N. Y.

*Cash Ready*

FOR YOUR

**ELECTRICAL EQUIPMENT**

Electric motors, AC and DC
Compensators
Generators
Motor Generator Sets
Air and Oil Circuit Breakers
Panels
Exhaust Fans
Control Equipment

*Send us list with full details*
WIRE OR PHONE
P. O. Box 534

**POWER EQUIPMENT CO.**
154 ANDREWS ST., ROCHESTER 4, N. Y.
Telephone Main 568 or 569

**WANTED**

**TURBO GENERATOR**

Bleeder type, 3750 to 7500 KVA 3/60/2300 inlet pressure 300 to 350 lbs. discharge pressure 125#.

IRON & STEEL PRODUCTS, INC.
13488 S. Brainard Ave., Chicago 33, Ill.
"*ANYTHING* containing IRON or STEEL"

**WANTED**

**Two D.C. MOTORS**

TYPE MPC, CLASS 6—150 H.P. 500, Form A, 500 R.P.M. 250 Volts, General Electric—150 H.P.

W-973, Power
330 West 42nd St., New York 18, N. Y.

# ASK YOURSELF FRANKLY "WILL IT PAY TO SELL MY BUSINESS?"

TODAY'S unusual industrial conditions may well justify you in turning your business—FOR CASH—to new management. As a reputable operating organization of long experience, with substantial capital, we can bring opportunity for increased company expansion and greater profits . . . while you are relieved of heavy expense and worry. Personnel held intact whenever possible.

• *ALL discussions and negotiations strictly confidential*

Box 1234—1474 Bway, N. Y.

**FOR SALE**

One (1) Worthington Triplex Water Pump —Serial D87393—6½" D x 8" S. Driving Pinion 34T. Bull Gear 164T. $500.00—A1 condition.

**SMITH PAPER, INC.**
Lee, Mass.

**FOR SALE**

Waterwheel and Generator. Pelton single overhung impulse wheel, designed to produce 120 hp. at 450 rpm. and net effective head of 333 feet. Direct connected to 80 kva Westinghouse generator 60 cycle, 3 phase, 2400 volts, complete with 5 kw. Westinghouse direct connected exciter. Location—Western Canada. Apply

FS-126, Power
330 West 42nd Street, New York 18, N. Y.

# WANTED

**We Will Buy**

WE WILL BUY
MOTORS — AC & DC
GENERATORS
MG SETS
TRANSFORMERS
Controls &
Switchboards
Air & Oil
Circuit Breakers

**ELECTRIC GENERATOR & MOTOR CO.**
4523 Hamilton Ave.
Cleveland 14, Ohio
Phone ENdicott 5656
*Established 1900*

**WANTED**

500 or 600 K.V.A. 60 cycle—3 phase oil cooled transformer primary 13200 volts secondary 240 volts. If possible state the impedance.

**RUNDLE MFG. CO.**
3305 West Forest Home Ave., Milwaukee, Wis.
Telephone Mitchell 1040
WIRE or PHONE collect.

**WANTED**

1—150 H.P. 100# pressure boiler and accessories
1—self supporting stack 3' x 85'
1—100 foot tank tower and 15000 gallon (or larger) water tank

**H. M. SHANDLES**
617 Pine Street, Philadelphia 6, Pa.

**WANTED**

500 to 750 KW 80% P.F., 3 phase 60 cycle, 2300 volt non-condensing turbo generator 175-200 lb., 100 degree superheat 20 lb. back pressure. State age, serial number, condition and price.

W-980, Power
520 North Michigan Ave., Chicago 11, Ill.

**WANTED URGENTLY**

**STEAM BOILER**

1 Steam boiler to produce about 80,000 lbs. steam per hour (capacity 80,000 lbs. water per hour evaporated). Pressure 400 lbs. per square inch, preferably fitted with chain grate stoker.

**Oilfield Equipment Company, Inc.**
30 Church St. New York, 7, N. Y.

**WANTED**

**ROLLER CHAIN**

ANY SIZE—ANY MAKE—
ANY QUANTITY
NEW OR USED

W-129, Power
330 West 42nd St., New York 18, N. Y.

**WANTED**

**DIESEL ENGINE**

Quarry requires Several Diesel Engines and Generator Sets. 120 to 500 HP.

W.-116, Power
330 West 42nd St., New York 18, N. Y.

**WANTED**

One or two G.E. 175 H.P. type D.M.C. class 209 (6-173 H.P.—500) form L, 500 RPM—230 Volt, direct current motors—

Reply 123 Power
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**WANTED**

2—800 KW) ALTERNATORS, 3 Phase, 60 Cycle,
2—1250 KW) 2300 Volts, 300 RPM, with Switchboards.
*Suitable for engine connection.*

**ALJON ELECTRIC DIESEL CO.**
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Main 4-3804

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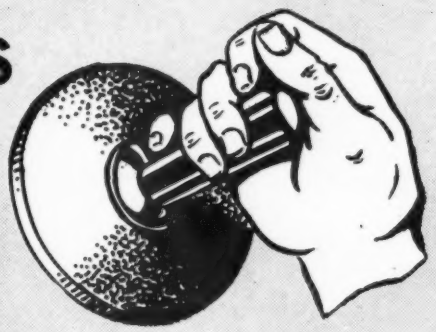


WHEN YOU buy Hemphill-owned Equipment, there is PREJUDGED VALUE packed in every crate . . . because OUR OWN buyers and electrical engineers have not only OK'd it for GOOD equipment . . . our REBUILDING experts have also tested and OK'd it to make sure that in workmanship and performance it meets MANUFACTURERS' standards.

**HEMPHILL STANDARDS ARE MAKERS STANDARDS**


### GASOLINE DRIVEN D. C. GENERATOR SETS

2—25 KW. 125 volt
1—30 KW. 125 volt
1—120 KW. A.C. 240 volt, 3 phase

### MOTORS 3 PHASE 60 CYCLE SQUIRREL CAGE

1—400 H.P. 1200 RPM. Westinghouse 220 volt
2—100 H.P. 1800 RPM. General Electric IK 440 volt
1— 90 H.P. 380 RPM. Crocker-Wheeler 550 volt
1— 75 H.P. 690 RPM. Westinghouse 550 volt
1— 60 H.P. 900 RPM. Howell Mfs. Co. SC. 220 volt
2— 50 H.P. 900 RPM. Fairbanks-Morse H. 220 volt
1— 50 H.P. 514 RPM. General Electric 1QK 220 volt
2— 25 H.P. 1800/1200/900/600 U. S., 440 volt, 3 phase

### MOTORS 3 PHASE 60 CYCLE SLIPRING

1—500 H.P. 900 RPM. Lincoln 440 volt
1—350 H.P. 293 RPM. General Electric MT-424 440 volt
1—250 H.P. 600 RPM. General Electric IM 2200 volt
1—225 H.P. 1800 RPM. General Electric I-E 220 volt
1—200 H.P. 600 RPM. Crocker Wheeler S.R. 440 volt
1—200 H.P. 600 RPM. Westinghouse CW 220 Volt
1—150 H.P. 1750 RPM. Westinghouse CW 220 volt
1—100 H.P. 900 RPM. General Electric MT vertical 220 volt
1—75 H.P. 1200 RPM. General Electric MT Vertical 220 volt.
1— 75 H.P. 900 RPM. General Electric ITC 220 volt
1— 60 H.P. 575 RPM. Allis-Chalmers 220 volt
1— 40 H.P. 1150 RPM. Cont Electric SA85 220 volt
1— 40 H.P. 1130 RPM. General Electric MT 2200 volt

### MOTOR GENERATOR SETS

1—300 K.W. General Electric, 3 unit, 2200 volt synchronous to 275 volt D.C., 720 RPM.
1—150 KW. 125 Volt Westinghouse, Squirrel Cage
1—100 KW. 230 Volt General Electric, 440 volt, 3 phase, 1200 RPM. Sq. Cage
1—80 KW. 230 volt 3 unit Crocker-Wheeler Synchronous 220 volt

### TURBO GENERATORS

1—600 KW. Terry dual bleeder condensing Turbine only
1—300 KW. 125/250 Volt General Electric non-condensing
1—200 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—200 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—30 KW. 135 volt, Allis-Chalmers, non-cond.

### ALTERNATORS

1—500 KW. 3600 RPM. 600 volt, General Electric D.C. exciter
1—200 KVA 3600 RPM. 240 volt, Allis-Chalmers D.C. exciter
1—180 KW. 514 RPM. 550 volt, Westinghouse
1—165 KW. 514 RPM. 2400 volt, Electric Mach.
1—62½ KW. 3600 RPM. 220 volt, Allis-Chalmers
1—40 KW. 1800 RPM. 550 volt, General Electric
1—35 KW. 1200 RPM. 240 volt, Columbia Electric D.C. exciter
1—31.3 KVA. 1200 RPM. 120/208 volt, American D.C. exciter
1—12.5 KVA. 1200 RPM. 240 volt, Westinghouse, D.C. exciter

### MOTORS—VARIABLE SPEED 230 VOLTS

2—200 H.P. 425/212 RPM. General Electric MPC
2—100 H.P. 950/1170 RPM. General Electric RC-37
1—40 H.P. 700/1000 RPM. Sprague L.C.
1—30 H.P. 400/120 RPM. General Electric R' C-204
1—30 H.P. 225/900 RPM. Crocker Wheeler CMC
1—25 H.P. 650/2200 RPM. Westinghouse SK-110L
1—25 H.P. 500/1500 RPM. General Electric RF-12
1—25 H.P. 400/1200 RPM. Westinghouse SK
2—25 H.P. 300/900 RPM. Electro Dynamic
1—15 H.P. 300/1200 RPM. General Electric RLC-2024
1—13/18 H.P. 350/1200 RPM. Electro Dynamic
3—11½ H.P. 500/1500 RPM. Westinghouse
1—7½/10 H.P. 500/1500 RPM. Reliance
1—6/7.5 H.P. 450/1800 RPM. Crocker Wheeler CMC
1—5 H.P. 500/1500 RPM. Reliance
1—5 H.P. 600/1200 RPM. General Electric LC
1—5 H.P. 450/1800 RPM. Crocker Wheeler CM
1—5 H.P. 400/1600 RPM. Diehl K6
1—5 H.P. 225/900 RPM. Electro Dynamic

### TRANSFORMERS

1—1000 KVA. Auto Transf. 4150 V. 3 Ph. 4 wire to 2406 V. 2 Ph.
2—400 KVA. General Electric, 4156-250/480 volt, Scott taps
3—200 KVA. Pittsburgh 2200 volt 110/220.
3—100 KVA. Westinghouse 11430/250 volt
3—100 KVA. General Electric 13200/250 volt
3— 75 KVA. General Electric 13500/750/440 volt
2— 50 KVA. Pittsburgh 7500/15000 V. 110/220 v.
2— 15 KVA. General Electric 2300-115/230 volt

### MOTORS D. C. 230 VOLTS

2—450 H.P. General Electric MPL 250 volt 400 RPM.
1—250 H.P. 750 RPM. Electro Dynamic 230 volt
1—125 H.P. 1725 RPM. General Electric RC—230 volt.
1— 75 H.P. 575 RPM. General Electric C 230 volt
4— 50 H.P. 700 RPM. Crocker Wheeler CM 230 volt
2— 30 H.P. 1150 RPM. General Electric RC-31 230 volt
1— 30 H.P. 1100 RPM. General Electric RC-12 230 volt
1— 30 H.P. 750 RPM. General Electric RC-14 230 volt
1— 30 H.P. 625 RPM. General Electric C 230 volt
1— 25 H.P. 1150 RPM. General Electric CD-93 230 volt
1— 25 H.P. 600 RPM. Westinghouse SK 230 volt
1— 20 H.P. 800 RPM. General Electric RC-12 230 volt
1— 15 H.P. 350 RPM. Diehl G-312 230 volt

### SYNCHRONOUS MOTORS

1—500 KVA. 900 RPM. type ATI General Electric 4150 volt, 3 phase, direct connected exciter.
2—160 H.P. 1800 RPM. Electric Machinery, 2200 volt.
1—75 H.P. General Electric, 1200 RPM. type ATI, 220 volt, 3 phase, 60 cycle.

### MISCELLANEOUS

2—2100 Gallon Pumps Dayton-Dowd 190 foot head.


JLH

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

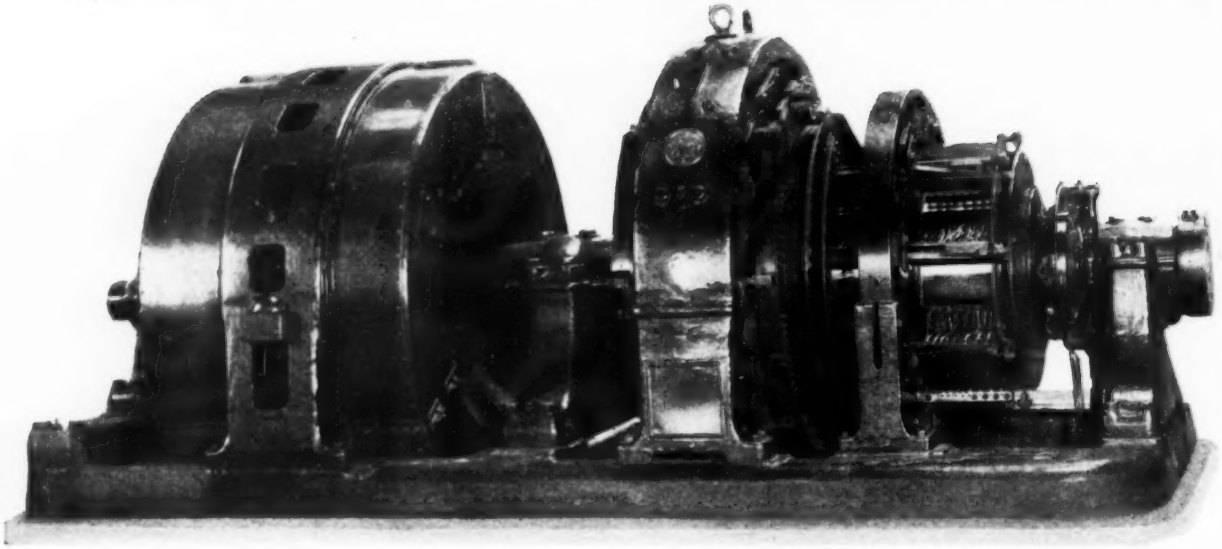
J.L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

# POWER PLANT MACHINERY



## 1800 KW GENERAL ELECTRIC SYNCHRONOUS MOTOR GENERATOR SET

1—1800 KW 50 deg. General Electric compound interpole direct current generator type MCF form L 275 volts 6550 amps. 600 RPM #1358377 mounted on common cast iron sub-base and direct connected to

1—2500 HP 85% P.F. 2400 KVA 50 deg. General Electric synchronous motor type ATI form C 3 phase 60 cycle 13200 volts (can be reconnected for 6600 or 2300 volts) 600 RPM #4097530

***The above motor generator set is in excellent condition, complete with automatic switching equipment and available immediate shipment.***

### TURBINE UNITS

3 phase, 60 cycle

35000 KVA G.E. 13800 V. Cond. 425#
15000 KVA G.E. 13800 V. Cond. 425#
7500 KVA G.E. 13800 V. Cond. 425#
5000 KVA G.E. 4000 V. Cond. 200#
3125 KVA G.E. 2300 V. Cond. 175#
2500 KVA G.E. 2300 V. Cond. 200#
2500 KVA Wstg. 2300 V. Cond. 200#
2500 KVA G.E. 480 V. Non. 175#
1875 KVA Wstg. 240 V. Bleed. 400#
1875 KVA Wstg. 240 V. Non. 400#
1563 KVA Allis 2300 V. Cond. 210#
1250 KVA Allis 480 V. Bleed. 150#
1250 KVA Wstg. 2300 V. Cond. 180#
937 KVA Allis 2300 V. Bleed. 175#
937 KVA Allis 2300 V. Non. 200#
625 KVA Wstg. 480 V. Bleed. 150#
625 KVA G.E. 240 V. Non. 200#

### UNIFLOW UNITS

3 phase, 60 cycle

1000 KVA Skinner 2300 V. 115#
750 KVA (2) Skinner 2300 V. 175#
500 KVA Skinner 480 V. 150#
350 KVA Ames 2300 V. 150#

### DIESEL UNITS

3 phase, 60 cycle

1875 KVA Hamilton 2400 V. 240 RPM
1000 KVA McInt. Sey. 4000 V. 300 RPM
500 KVA Fair. Mor. 2400 V. 257 RPM
375 KVA DeLav. 2300 V. 240 RPM
375 KVA (2) DeLav. 4000 V. 300 RPM
312 KVA Bus. Sul. 2300 V. 225 RPM
300 KVA Fair. Mor. 2300 V. 257 RPM
156 KVA Buckeye 240 V. 360 RPM
150 KVA Fair. Mor. 2400 V. 257 RPM

### ROTARY CONVERTERS

3 phase, 60 cycle

2500 KW G.E. Boost. 300 D.C. 4600 A.C.
1500 KW Wstg. 250 D.C. 2300 A.C.
1000 KW (4) G.E. 600 D.C. 33000 A.C.

### MOTOR GENERATORS

3 phase, 60 cycle

300 KW C.W. Syn. 250 D.C. 4000 A.C.
200 KW G.E. Syn. 275 D.C. 2300 A.C.
150 KW Wstg. Syn. 125 D.C. 2200 A.C.

### WATER TUBE BOILERS

25,000 lbs/hr Stirling (2) 425# Pulverizer
60,000 lbs/hr Springfield 225#, Pulverizer

## INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

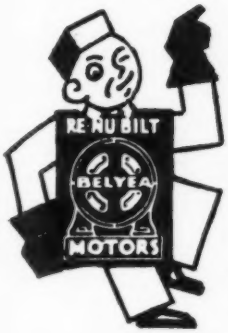
*Typical!*

*What* BELYEA

RE-NU-BILT

*Signifies*

It means YOU—the buyer and user—get the benefit of 38 years of experience in selecting and buying quality equipment, rebuilding it, and testing it the highest of standards. The list shown below is only a sample of present stock.




*This Explains Our Statement...*

## "SUCCESSFUL OPERATION GUARANTEED"

### MOTOR GENERATOR SETS

**3 phase—60 cycle**

1—1500 KW. G.E. 275 V. D..C to 2100 H.P. 4400/2200 V. Syn. with exciter.
1—400—3 unit with 2—200 KW—GE DC gens. and 700 HP. 2300 v.
1—300 KW—Cr. Wh. 3 unit with 150 KW. 125 v. D.C. gens. and 450 HP—4150 v. Syn.
1—175 KW. Whse. 250 v. D.C. to 312 Kva., 2300 v. Syn. with exciter.
1—150 KW—Whse. 600 V. D.C. to 200 HP—2200 V.
1—150 KW Whse. 3 unit (2) 75 KW 125 V. Gen. D.C. to 200 HP—2300 V. Ind.
1—75 KW GE 125 V. D.C. to 120 HP—2300/4000 V. Ind.
1—50 KW GE 125 V. D.C. to 75 HP—2300/4000 V. ind.
2—48 KW. 3 unit with 2—24 KW GE 60 volt D.C. gens and 60 HP—440 v. Sq. Cg.
1—45 KW. Whse. 250 V. D.C. to 75 HP. 440 V.
1—26.4 KW W.E. 33 v. 800 amp. D.C. to 41.5 HP. 220 v. Sq. Cg.
1—20 KW Burke 115 v. D.C. to 30 HP 440 v.—Sq. Cg.
1—19.8 KW W.E. 33 v. 600 amp. D.C. to 32 HP. 230 v. Sq. Cg.

**SPECIAL**
**1—500 KW—GE 250 V D C. to 700 HP—2300/4150 Syn. Motor—3 phase—25 cycle with Controls.**

### TRANSFORMERS—60 Cycle

| Qu. | Kva. | Make | Ph. | Type | Voltages |
|---|---|---|---|---|---|
| 3 | 1667 | Pitts. | 1 | OISC | 13200x2300 |
| 1 | 1050 | G.E. | 3 | WCTH | 11000x445/222½ |
| 4 | 525 | G.E. | 1 | HJ | 2300x445 |
| 2 | 333 | Pitts. | 1 | OISC | 2400x220 |
| 1 | 300 | Pitts. | 3 | OISC | 4150x208/120 |
| 3 | 200 | G.E. | 1 | HLLD | 27600x115/460 |
| 3 | 200 | G.E. | 1 | HJ | 2300x408/204 |
| 1 | 200 | G.E. | 2-3 | Auto | 2500x2500 |
| 1 | 200 | G.E. | 1 | H | 2300x115/230 |
| 3 | 100 | G.E. | 1 | HJDD | 13200x445/226 |
| 3 | 100 | Whse. | 1 | OISC | 13200x250 |
| 3 | 50 | Pack. | 1 | OISC | 2200x110/220 |

### A. C. MOTORS

**3 Phase—60 Cycle**

**SLIP RING**

| Qu. | H.P. | Make | Volts | R.P.M. | Desc. |
|---|---|---|---|---|---|
| 1 | 2500 | G.E. | 6600 | 253 | MT |
| 1 | 800 | Al. Ch. | 440 | 885 | ANY |
| 1 | 600 | Cr. Wh. | 2200 | 507 | 131 AQ |
| 1 | 600 | Whse. | 440 | 400 | CW |
| 1 | 350 | G.E. | 4000/2300 | 253 | MT-442Y |
| 1 | 250 | G.E. | 4000 | 257 | MT-424Y |
| 1 | 225 | G.E. | 550 | 720 | IM-17 |
| 1 | 200 | G.E. | 440 | 450 | IM-3 Brg. |
| 1 | 100 | G.E. | 500 | 685 | MTC-5552 |
| 1 | 80 | G.E. | 440 | 860 | MTC-542 |
| 1 | 75 | G.E. | 2200 | 900 | MT-356 |
| 1 | 60 | G.E. | 2200 | 1755 | MT-337 |

**SQUIRREL CAGE**

| | | | | | |
|---|---|---|---|---|---|
| 1 | 725 | G.E. | 13800/2300 | 600 | KT |
| 1 | 400 | G.E. | 2200 | 1175 | IE-15B |
| 1 | 400 | Whse. | 2200 | 585 | CS-1104 |
| 1 | 300 | G.E. | 2200 | 600 | IK |
| 1 | 300 | G.E. | 440 | 900 | IK |
| 1 | 200 | G.E. | 550 | 580 | IK |
| 2 | 200 | G.E. | 2300 | 1175 | IK |
| 1 | 200 | G.E. | 440 | 580 | IK |
| 1 | 200 | Al. Ch. | 2300 | 1175 | |
| 2 | 175/112 | G.E. | 440 | 900/720 | IK |
| 1 | 150 | Whse. | 550 | 400 | CS-594A |
| 3 | 150 | G.E. | 440 | 1200 | K-63258B. Brg |
| 1 | 150 | G.E. | 440 | 600 | IK |
| 2 | 100 | G.E. | 440 | 900 | IK |

**SYNCHRONOUS**

| | | | | | |
|---|---|---|---|---|---|
| 2 | 2100 | G.E. | 2200/4400 | 514 | ATI |
| 1 | 700 | Whse. | 4600/2300 | 1200 | |
| 1 | 600 | Al. Ch. | 2200 | 720 | |
| 1 | 125 | G.E. | 2300 | 900 | ATI |
| 1 | 75 | G.E. | 220 | 600 | TS-7556 |

**SYNCHRONOUS CONDENSER**

| | | | | | |
|---|---|---|---|---|---|
| 1 | 5000 | Whse. | 2300/4000 | 900 | |

### ROTARY CONVERTER

**3 PHASE—60 CYCLE**

| Qu. | Kw. | Make | Speed | D.C.V. | Trans. V |
|---|---|---|---|---|---|
| 1 | 1500 | Whse. | 720 | 600 | 2300 |
| 1 | 1500 | Whse. | 600 | 600 | 11500 |
| 1 | 1250 | G E. | 720 | 250 | 2300 |
| 1 | 1000 | G.E. | 900 | 600 | 13200 |
| 1 | 1000 | Whse. | 900 | 600 | 11000 |
| 1 | 750 | Whse. | 750 | 250 | 6600/2300 |
| 1 | 500 | Whse. | 1200 | 600 | 13200/2300 |

**3 PHASE—25 CYCLE—BOOSTER TYPE**

| | | | | | |
|---|---|---|---|---|---|
| 2 | 1500 | G.E. | 500 | 225/275 | 13200/6600 |

All units can be furnished with A. C. & D. C. control

**SPECIAL**
**1—2000 amp., 3 pole, 15000 V. Conduit type F-120-15 D, 230 V Sol. operated OCB —1000 000 uninterrupting Capacity.**

### D. C. MOTORS

| Qu. | H.P. | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 2 | 1250 | G.E. | MPC | 500 | 130 |
| 1 | 800 | G.E. | MPC | 550 | 600 |
| 2 | 700 | G.E. | MCF | 600 | 150/525 |
| 1 | 650 | G.E. | MPC | 250 | 115/145 |
| 2 | 625 | G.E. | MPC | 500 | 130 |
| 1 | 300/400 | Sprague | TLC | 250 | 1325/2500 |
| 3 | 350 | G.E. | MPC | 230 | 450 |
| 1 | 300 | G.E. | MPC | 230 | 275/550 |
| 1 | 300 | G.E. | DMC | 230 | 400/600 |
| 2 | 300 | Cr. Wh. | CCM-151H | 230 | 630/700 |
| 1 | 250 | G.E. | MPC | 230 | 400/500 |
| 1 | 250 | A. Ch. | | 230 | 525 |
| 1 | 250 | Whse. | SK | 230 | 275/690 |
| 2 | 135/175 | G.E. | MCF | 230 | 450/1050 |
| 1 | 150 | G.E. | MPC | 230 | 250/450 |
| 2 | 130 | Cr. Wh. | CMC-65H | 550 | 1200 |
| 2 | 125 | G.E. | CO-183A | 230 | 625 |

### TURBO GENERATOR SETS

1—500 KW—Whse. 625 KVA. 440 v. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lbs. condensing turbine with jet condenser and accessories.
1—75 KW Ridgeway 250 V. D.C. with Terry 180 lb. with 12 lb. back pressure, 2000 RPM.

**38TH YEAR OF SERVICE**

WE OWN WHAT WE ADVERTISE IT HAS TO BE GOOD!

# BELYEA COMPANY, INC.

**We Buy for Stock — for CASH**
**What Surplus Do You Have?**
**PHONE—JOURNAL SQUARE — 2-3334**
*Also*
**N. Y. CITY LINE — RECTOR 2-7150**

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**43 HOWELL STREET**
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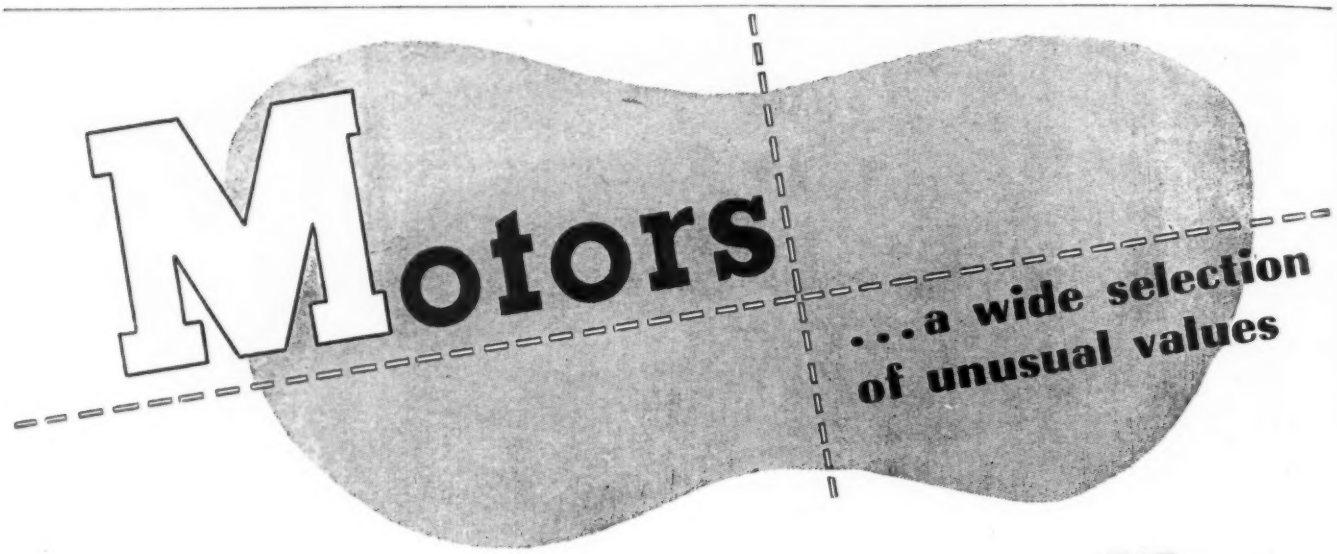


# Listed below a few of the motors available in a hurry from Wente

## SQUIRREL CAGE

### 3 Phase, 60 Cycle, 220/440 Volt

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 2 | | 200 KW West. M-G sets, 2200 to 250 Volt, DC complete 1 year old. | | |
| 1 | 150 | Al. Ch. | | 1750 |
| 1 | 150 | G.E. 2200 v. IK | | 720 |
| 2 | | 150 KW West. syn. M-G sets 2200 to 250 Volt, DC complete | | |
| 1 | | 100 KW Gen. Elec. syn. M-G sets 2200 to 250 Volt, DC complete | | |
| 1 | 100 | G.E. 2200 v. IK | | 600 |
| 1 | 100 | West. 2200v. CS | | 1800 |
| 1 | 100 | R'way 440v. | | 1200 |
| 1 | 100 | West. 2000v. CCL | | 1720 |
| 1 | 100 | G.E. | I | 340 |
| 1 | 100 | G.E. | I | 290 |
| 1 | 75 | Lincoln | C10 | 1200 |
| 1 | 75 | F.M. 550v. | H165C | 900 |
| 1 | 75 | Lincoln | IQ | 600 |
| 1 | 75 | G.E. | KT562 | 450 |
| 6 | 75 | G.E. 440 v. new Ball Bearing | K | 1800 |
| 1 | 75 | Rel. new 440 v. Ball Bearing, splash proof | | 1200 |
| 1 | 75 | Cont. new 440 v. Ball Bearing, splash proof | | 1800 |
| 1 | 50 | Al. Ch. | TEFC | 900 |
| 1 | 50 | G.E. | I | 720 |
| 2 | 50 | West. | MS 25 cy. | 720 |
| 1 | 50 | Wag. | BM | 495 |
| 1 | 50 | Al. Ch. | | 490 |
| 1 | 40 | Triumph | B12 | 850 |
| 2 | 35 | Al. Ch. | 2 ph. | 865 |
| 2 | 35 | Al. Ch. | | 865 |
| 1 | 35 | F. Wayne | 2 ph. | 900 |
| 1 | 35 | G.E. | 25 cy. | 730 |
| 1 | 30 | F.M. 2200v. | HD12B | 3600 |
| 1 | 30 | Howell | SC | 1200 |
| 1 | 30 | Al. Ch. | | 1200 |
| 1 | 30 | Louis A. | P405 | 1140 |
| 1 | 30 | Louis A. | KH | 1170 |
| 7 | 30 | G.E. | KT526 | 1200 |
| 1 | 30 | West. | CCL | 900 |
| 1 | 30 | Wagner | 22VBR | 860 |
| 1 | 30 | Elng. Weld | ED445TEFC | 850 |
| 1 | 30 | Al. Ch. | | 860 |
| 2 | 30 | Al. Ch. | AN 2 ph. | 860 |
| 1 | 30 | Century | AS 25 cy. | 720 |
| 5 | 30 | West. new B.B. 440v. | | 1750 |
| 1 | 30 | U.S. B.B. 440v. | | 1160 |
| 7 | 25 | West. new B.B. 440v. | | 1160 |
| 6 | 25 | G.E. B.B. 440v. | | 1160 |
| 1 | 25 | R. & M. | K207 | 1750 |
| 1 | 25 | Howell | | 1200 |
| 1 | 25 | Lincoln | | 900 |
| 1 | 25 | G.E. | KT332 | 900 |
| 1 | 25 | Al. Ch. | | 860 |
| 1 | 25 | Rel. (elevator) T. E. | | 750 |
| 1 | 25 | Al. Ch. | | 720 |
| 1 | 25 | G.E. | M10 | 720 |
| 1 | 25 | West. | CS644C | 690 |
| 1 | 20 | West. | CCL | 3600 |
| 1 | 20 | Al. Ch. | | 1700 |
| 1 | 20 | Century | | 1740 |
| 1 | 20 | F. M. | KRV | 1200 |
| 1 | 20 | West. | | 1200 |
| 1 | 20 | Wagner | | 1150 |
| 1 | 20 | Ideal | A | 1150 |
| 2 | 20 | Wagner | HRP404 | 1060 |
| 1 | 20 | Cleve. | M-147 | 900 |
| 1 | 20 | Al. Ch. | | 860 |
| 1 | 20 | R. & M. | K-207 | 900 |
| 1 | 20 | West. | CS-644 | 870 |
| 1 | 20 | West. | MS | 900 |
| 1 | 20 | F. M. | H | 870 |
| 1 | 20 | West. | CCL | 580 |
| 1 | 20 | Wagner | CM | 445 |
| 5 | 20 | Louis-Allis T.E.F.C.B B. 440v. | | 1750 |
| 1 | 18 | West. | MS-4 (Elev.) | 720 |
| 1 | 15 | West. | CCL | 1700 |
| 1 | 15 | Wagner | 13VRW | 1725 |
| 1 | 15 | Rel. | B326 | 1750 |
| 1 | 15 | Wagner | 13VRW 2 ph. | 1725 |
| 6 | 15 | G.E.-B.B.S.P. new 440v. | | 1750 |
| 1 | 15 | Cr. Wh. | 1150 | 1720 |
| 1 | 15 | West. | CS-460C | 1200 |
| 1 | 15 | Wagner | 15TCP-TEFC | 1140 |
| 1 | 15 | G.E. | KT512 | 875 |
| 2 | 15 | West. | CS-573 25 cy. | 725 |
| 2 | 15 | West. | MS 25 cy. | 725 |
| 1 | 15 | West. | CS567C 25 cy. | 715 |
| 1 | 15 | West. | MS 25 cy. | 600 |
| 1 | 10 | Al. Ch. | | 3450 |
| 1 | 10 | G.E. | KT302 | 900 |
| 1 | 10 | West. | CS 25 cy. | 725 |
| 1 | 10 | West. | MS 25 cy. | 720 |
| 2 | 10 | West. | CS473C 25 cy. | 615 |
| 10 | 10 | West. new B.B. 440v. | | 1750 |
| 6 | 10 | Lima new T.E.F.C.B.B. 440 v. | | 1750 |
| 14 | 7½ | West. new B.B. 440v. | | 1750 |
| 1 | 7½ | Al. Ch. | | 860 |
| 1 | 7½ | Wagner | MCP-365 | 1140 |
| 1 | 7½ | Lima | RS-405 b.b. | 514 |
| 150 | 5 | Wagner new B.B.S.P. 440 v. | | 1750 |
| 11 | 5 | West. new B.B. 440 v. | | 1160 |
| 40 | 3 | Imperial new B.B. 440v. | | 1160 |

## SLIP RING

### 3 Phase, 60 Cycle, & Syn.

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 443 | El. Mach. | | 900 Syn. |
| 1 | 300 | G.E. | MT412 | 352 |
| 1 | 275 | Al. Ch. | | 1170 |
| 1 | 200 | F. M. | BV | 600 |
| 1 | 200 | Al. Ch. | | 1175 |
| 1 | 200 | Westg. 2200 v. | | 600 Syn. |
| 2 | 75 | F. M. 2200v. | BV-H16B | 1800 |
| 1 | 75 | G.E. | MT552 | 865 |
| 1 | 65 | Al. Ch. Alt. | | 1200 |
| 1 | 50 | G.E. | IM | 1150 |
| 1 | 50 | Triumph | C12 | 1150 |
| 1 | 50 | G.E. | IM | 900 |
| 1 | 50 | G.E. | IM 25 cy. | 700 |
| 1 | 50 | Al. Ch. | | 690 |
| 1 | 50 | Ideal | | |
| 2 | 40 | G.E. | MT336 | 1200 |
| 1 | 40 | Al. Ch. | | 1160 |
| 1 | 40 | W'g 2200v. | CW | 870 |
| 1 | 40 | Westg. | CW-653A | 870 |
| ½ | 40 | Al. Ch. | | 870 |
| 1 | 40 | G.E. | MY-W | 880 |
| 1 | 40 | Westg. | C1753A 25 cy. cr. | 730 |
| 10 | 35, 15 | G.E. | OMT336 | 1150/550 |
| 1 | 35 | Al. Ch. | 25 cy. | 720 |
| 2 | 35 | G.E. | IM | 570 |
| 1 | 30 | F. M. | AD Alt. | 1200 |
| 1 | 20 | Imperial | DW-D37 | 1800 syn. |
| 1 | 22 | G.E. | ITC5011 (hoist) | 680 |
| 1 | 25 | Westg. | MW 322A | 680 |
| 1 | 25 | G.E. | MT342 | 600 |
| 1 | 25 | G.E. | MT356 | 400 |
| 1 | 20 | Triumph | C10 | 1200 |
| 2 | 15 | G.E. | MT302 | 1200 |
| 1 | 15 | G.E. | MT332 | 720 |
| 1 | 15 | Triumph | C11 | 685 |
| 1 | 15 | Westg. | CS | 585 |
| 1 | 15 | G.E. | MT556 | 280 |
| 1 | 10 | Westg. | CW364 (Ex. proof) | 1750 |
| 3 | 10 | Westg. | CW464A | 1200 |
| 1 | 10 | Westg. | HF | 1140 |
| 1 | 10 | W. E. | | 1200 |
| 1 | 10 | G.E. | IM | 1200 |
| 1 | 7½ | G.E. | MT182 | 1750 |
| 1 | 7½ | Westg. | CW-452A | 1200 |

### DC—230 Volt

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 75 | Diehl | K11 | 700 |
| 1 | 100 | G.E. | CD 123 | 1200 |
| 1 | 60 | Westg. 115v. | SK140L Bert. | 1140 |
| 1 | 60 | G.E. | EF1 | 1200 |
| 1 | 40 | Rel. 440 v. | 13LT Vert. | 1750 |
| 1 | 40 | Rel. 440 v. | 230T Vert. | 1130 |
| 1 | 25 | C.W. 440 v. | CMC-EH Vert. | 1150 |
| 2 | 40 | Westg. | SK 123 | 1150 |
| 3 | 40 | G.E. | RC 32 | 1100 |
| 8 | 40 | Westg. | SK 140 | 775 |
| 1 | 35 | R. C. | 11B | 1500 |
| 1 | 35 | Al. Ch. | | 1200 |
| 1 | 35 | G.E. | DLC 203 | 700 |
| 1 | 35 | Westg. | SK 163 Vert. | 300/1200 |
| 1 | 30 | El. Dy. | 158 | 625 |
| 1 | 30 | Westg. | SK 110L | 1150 |
| 1 | 30 | Rel. 440 v. | 131 T Vert. | 1150 |
| 4 | 30 | Reliance | 92 TF | 1750 |
| 1 | 27½ | G.E. | CVC 116 | 1750 |
| 1 | 25 | Westg. | SK 120 | 825 |
| 1 | 25 | Westg. | SK 103 | 1150 |
| 1 | 25 | Westg. | SK 90 | 1400 |
| 4 | 25 | Westg. | SK 100 L | 1150 |
| 1 | 30 | G.E. | RC 51B | 1150 |
| 1 | 25 | Sprague | | 850/2000 |
| 1 | 25 | Westg. | SK 123 | 550/1100 |
| 1 | 25 | Al. Ch. | E 120 | 500/1500 |
| 1 | 25 | G.E. | RF 12 | 400/1200 |
| 2 | 25 | Westg. | SK | 400/1200 |
| 1 | 25 | J. & L. | | 625 |
| 2 | 20 | Reliance | 131T | 1000 |
| 2 | 20 | Diehl | K914A | 500/1500 |
| 2 | 20 | Westg. | SK113 | 500/1500 |
| 1 | 20 | G.E. | RF12 | 250/1000 |
| 1 | 20 | Lincoln | FKW B.B. | 1800 |
| 2 | 20 | Westg. | SK70L | 1700 |
| 6 | 20 | Cr. Wh. | CMC T.E.B.B. | 1750 |
| 1 | 20 | Cr. Wh. | CMC T.E.B.B. | 1150 |
| 1 | 20 | Westg. | SK93 | 1150 |
| 11 | 20 | Reliance | 92T | 1150 |
| 1 | 20 | Westg. | SK120 T.E. | 1100 |
| 3 | 20 | Westg. | SK100L | 900 |
| 1 | 20 | Watson | K | 850 |
| 3 | 20 | Reliance | 131T | 850 |
| 1 | 20 | G.E. | RC30 | 750 |
| 1 | 20 | Westg. | SK110L-115V | 750 |

### DC—230 Volt

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 4 | 20 | Westg. | SK110L | 750 |
| 1 | 20 | Cr. Wh. | CW-CMC | 600 |
| 1 | 20 | Westg. | SK120 | 500 |
| 3 | 20 | Al. Ch. | K | 500/1000 |
| 1 | 15 | Reliance | 46TF | 1750 |
| 2 | 15 | Westg. | SK63 | 1750 |
| 1 | 15 | Westg. | SK113 encl. | 1750 |
| 1 | 15 | G.E. | RC29A | 1700 |
| 1 | 15 | Westg. | SK93 | 1150 |
| 4 | 15 | Westg. | SK83 | 1150 |
| 4 | 15 | Cr. Wh. | CW-CCM T.E. | 1150 |
| 1 | 15 | Westg. | SK70L | 1250 |
| 1 | 15 | G.E. | CD83 | 1150 |
| 1 | 15 | G.E. | RC10 | 1150 |
| 1 | 15 | G.E. | RC29 | 1150 |
| 4 | 15 | Westg. | SK93 | 850 |
| 4 | 15 | Reliance | 92TF | 850 |
| 4 | 15 | R. & M. | | 1000 |
| 1 | 15 | G.E. | CVC-115 | 925 |
| 6 | 15 | Westg. | SK90 Vert. | 825 |
| 1 | 15 | G.E. | RC29 | 750 |
| 6 | 15 | Westg. | SK110L | 675 |
| 1 | 15 | Al. Ch. | | 1075 |
| 8 | 15 | Reliance | 131T | 250 |
| 3 | 15 | Reliance | 92T | 850/1700 |
| 1 | 15 | Reliance | 66T | 800/1600 |
| 1 | 15 | Westg. | SK | 500/1500 |
| 2 | 15 | Westg. | SK110L | 400/1600 |
| 1 | 15 | Triumph | 32F | 300/600 |
| 1 | 15 | Triumph | | 225/900 |
| 1 | 12½ | Westg. | SK | 750/1500 |
| 7 | 10 | Westg. | SK70 | 850 |
| 2 | 10 | Reliance | 66TF | 850 |
| 2 | 10 | G.E. | RC29 | 850 |
| 20 | 10 | Westg. | SK60L-SK60-Reliance 46TF | 1150 |
| 10 | 10 | Cr. Wh. | CM-CHB T.E.B.B. | 1750 |
| 4 | 10 | Westg. | SK43 | 1700 |
| 1 | 10 | G.E. | RF11 | 600/2400 |
| 4 | 10 | G.E. | RF10 | 600/1800 |
| 6 | 10 | Westg. | SK80L | 500/1500 |

### DC—230 Volt

| Qu. | HP | Make | Type | R.P.M. |
|---|---|---|---|---|
| 23 | 10 | Al. Ch. | | 500/1000 |
| 1 | 10 | G.E. | RF10 | 400/1200 |
| 2 | 10 | Kimble | BA324 new B.B. | 1750 |
| 1 | 10 | Westg. | SK91 | 250/1000 |
| 21 | 7½ | Westg. | SK33 | 1750 |
| 16 | 7½ | Westg. | SK43 | 1150 |
| 20 | 7½ | Westg. | SK60 | 850 |
| 20 | 5 | Westg. & G.E. | | 1750 |
| 60 | 5 | Westg. Rel. | | 1150 |
| 50 | 5 | Westg. | SK43 | 850 |
| 75 | 3½ | Westg. | SK33 | 850 |
| 80 | 3 | Westg. | CD925 | 1725 |
| 120 | 3 | Westg. | SK20 | 1150 |
| 60 | 2 | Westg. | SK & CD | 1150 |
| 50 | 2 | Westg. | SK20 | 850 |
| 40 | 1½ | Westg. | CD | 1150 |
| 30 | 1½ | Westg. | CD925 | 550/2200 |

The Wente Electric Co.

Hamilton, Ohio

**Rebuilt Motors & Generators**

*Since 1906*

# Dependable Rebuilt Electrical Equipment

## 1 YEAR GUARANTEE

### 3 Ph. Squirrel Cage Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 150 | G.E. | KT-547S | 1750 |
| 4 | 150 | El-Mchy. | | 1150 |
| 1 | 125 | West. | CS | 1150 |
| 1 | 147 | West. | 25 cyc. | 715 |
| 2 | 100 | G.E. | BTA-440V. | 375 750 |
| 1 | 90 | Burke | EM7 | 1150 |
| 1 | 70 | G.E. | Synch. | 1200 |
| 1 | 60 | Burke | | 575 |
| 3 | 60 | G.E. & West. | | 690 |
| 1 | 50/25 | G.E. | KG-504 | 1750/885 |
| 1 | 50 | G.E. | KT-326 | 1750 |
| 1 | 50 | Star | A-75 | 1750 |
| 1 | 50 | West. | CCL | 1150 |
| 1 | 50 | Cr. Wh. | 1220 | 1150 |
| 1 | 50 | Cr. Wh. | 122Q | 865 |
| 1 | 50 | West. | CS | 580 |
| 1 | 50 | G.E. | I-14 | 495 |
| 1 | 46 | W.E. | | 150 900 |
| 1 | 40 | Triumph | TR | 690 |
| 1 | 40 | W.E. | | 150 900 |
| 1 | 35 | Wagner | | 850 |
| 1 | 30 | U.S. | Vert. | 3450 |
| 1 | 30 | Cr. Wh. | | 870 |
| 1 | 30 | Watson | | 850 |
| 1 | 30 | West. | CCL | 690 |
| 1 | 25 | Wagner | Fy. Weich. | 1200 |
| 1 | 25 | Wagner | Vert. | 1160 |
| 2 | 25 | West. | CS | 1160 |
| 1 | 25 | Century | AS-35 | 870 |
| 1 | 25 | G.E. | IK | 870 |
| 1 | 25 | Wagner | Fy. Weich. | 720 |
| 1 | 20 | G.E. | KT-312 | 1700 |
| 1 | 20 | G.E. | Vert. | 1750 |
| 1 | 20 | R & M | K-207 | 1160 |
| 1 | 20 | West. | CS | 1150 |
| 1 | 20 | G.E. | Vert. | 1175 |
| 1 | 20 | Al. Ch. | | 870 |
| 1 | 20 | Diehl | | 860 |
| 1 | 15 | G.E. | KT-752 | 1750 |
| 1 | 15 | Wagner | Fy. Weich. | 1800 |
| 1 | 15 | El. Spec. | Synch. | 1800 |
| 1 | 15 | G.E. | KT-312 | 1150 |
| 1 | 15 | Howell | | 1150 |
| 1 | 15 | Al. Ch. | | 1150 |
| 1 | 15 | G.E. | | 1150 |
| 1 | 15 | Lincoln | | 1150 |
| 4 | 15 | West. | MS | 1150 |
| 1 | 15 | G.E. | Vert. | 870 |
| 1 | 15 | G.E. | KT-512 | 870 |
| 1 | 15 | Wagner | 15VPR | 860 |
| 1 | 15 | Wagner | Fy. Weich. | 720 |
| 1 | 15 | West. | CS-504 | 415 |

### 2 Ph. Squirrel Cage Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 100 | West. | CS-663C | 1750 |
| 1 | 70 | G.E. | Synch. | 1200 |
| 1 | 75 | G.E. | IQE | 1750 |
| 1 | 50 | Lincoln | C-15 | 870 |
| 1 | 50 | G.E. | IQ | 870 |
| 1 | 40 | Al. Ch. | | 870 |
| 1 | 35 | Al. Ch. | | 870 |
| 1 | 30 | West. | CCL | 1150 |
| 1 | 30 | Wagner | BP | 1140 |

**NEW MOTORS**

**3 ph. 60 cy. 440 Volts**

**Wagner, Star, G.E., West., etc.**

**53— 5 HP 1800 RPM, S.P.**
**14— 5 HP 1800 RPM, T.E.F.C.**
**7— 5 HP 1200 RPM, T.E.F.C.**
**57— 7½ HP 1800 RPM, S.P.**
**46—10 HP 1800 RPM, S.P.**
**12—15 HP 1800 RPM, S.P.**
**11—20 HP 1800 RPM, S.P.**
**12—25 HP 1800 RPM, S.P.**
**8—25 HP 1800 RPM, T.E.F.C.**

### 2 Ph. Squirrel Cage Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 25 | Burke | | 870 |
| 3 | 25 | G.E. | IQL | 1150 |
| 1 | 25 | West. | CCL | 1150 |
| 1 | 15 | F-M | | 1750 |
| 1 | 15 | Wagner | | 1750 |
| 1 | 15 | G.E. | KQ-502 | 1150 |
| 1 | 15 | West. | CS | 1155 |
| 1 | 15 | Al. Ch. | | 1130 |
| 1 | 15 | West. | CS-572 | 860 |
| 1 | 15 | G.E. | IQ | 690 |

### A.C. Slip Ring Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 112 | G.E. | ITC | 720 |
| 1 | 100 | F-M | BA | 720 |
| 1 | 79 | West. | CW | 1170 |
| 1 | 75 | Al. Ch. | Hoist | 575 |
| 1 | 64 | G.E. | MTO-552 | 585 |
| 1 | 60 | West. | CW-956A | 290 |
| 1 | 50 | G.E. | MT | 600 |
| 1 | 52 | G.E. | ITC | 860 |
| 1 | 50 | Al. Ch. | | 865 |
| 1 | 50 | G.E. | MT-342 | 860 |
| 1 | 40 | West. | HF | 850 |
| 1 | 40 | Lincoln | IXL | 690 |
| 1 | 40 | G.E. | MT-352 | 570 |
| 1 | 35 | Al. Ch. | | 870 |
| 1 | 35 | Burke | DMB-7 | 720 |
| 1 | 30 | G.E. | ITC | 1200 |
| 1 | 30 | G.E. | M-526 | 1150 |
| 1 | 30 | G.E. | MQ-332 | 870 |
| 1 | 30 | West. | CI-574A | 870 |
| 4 | 30 | West. | CI-582C | 870 |
| 2 | 30 | G.E. | MT-542 | 690 |
| 2 | 25 | Al. Ch. | | 870 |
| 1 | 25 | Howell | SRS-420 | 870 |
| 1 | 25 | G.E. | 1M | 565 |
| 1 | 20 | West. | | 870 |
| 1 | 20 | G.E. | MT-332 | 600 |
| 1 | 15 | G.E. | MT-502 | 1130 |
| 1 | 15 | West. | CW | 870 |
| 1 | 15 | G.E. | MT-512 | 845 |

### A.C. Slip Ring Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 15 | Al. Ch. | | 680 |
| 1 | 15 | G.E. | MQ-332 | 670 |

### A.C. Generators

| Qu. | K.W. | Make | Voltage | Speed |
|---|---|---|---|---|
| 1 | 106 | El-Mchy. | 208/120 | 1200 |
| 1 | 150 | G.E. | 240/480 | 600 |
| 1 | 100 | West. | 240/480 | 600 |
| 1 | 50 | F-M | 240/480 | 1200 |
| 1 | .50 | El. My. | 208/120 | 900 |
| 1 | 30 | Burke | 220/440 | 900 |
| 2 | 30 | Century | 208/120 | 1200 |

### 230 Volt D.C. Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 350 | West. | SK | 340/425 |
| 1 | 75 | West. | SK151 | 250/1000 |
| 1 | 60 | G.E. | C-Inter. | 480/1100 |
| 1 | 50 | G.E. | RC-19 | 400/1200 |
| 1 | 45 | Diehl | K-10 | 850 |
| 1 | 40 | G.E. | DLC | 1050 |
| 2 | 35 | West. | SK-120 | 1150 |
| 1 | 35 | G.E. | RLC-204 | 440/800 |
| 2 | 35 | West. | SK-160 | 400/600 |
| 1 | 30 | G.E. | RC-32 | 1100 |
| 1 | 30 | West. | SA | 500/1500 |
| 3 | 25 | G.E. | RC-31 | 1150 |
| 1 | 25 | West. | SK | 1100 |
| 1 | 25 | Reliance | 92T | 1150 |
| 1 | 25 | Al. Ch. | | 850 |
| 1 | 25 | Rel. | MS | 500/1500 |
| 1 | 25 | Rel. | H3 | 400/1200 |
| 1 | 25 | G.E. | RF | 400/1200 |
| 3 | 20 | G.E. | RF | 500/1500 |
| 1 | 20 | G.E. | RF | 400/1200 |
| 1 | 20 | G.E. | CD-83 | 1200 |
| 1 | 20 | R. & M. | | 1160 |
| 1 | 20 | G.E. | RC-11 | 1150 |
| 1 | 20 | El. Dyn. | 7½-S | 950 |
| 3 | 20 | West. | SK-110L | 750 |
| 1 | 20 | West. | Hoist | 700 |
| 1 | 15 | Rochester | | 3450 |
| 1 | 15 | West. | SK-83 | 1150 |
| 2 | 15 | G.E. | RC | 1150 |
| 1 | 15 | G.E. | CD-Vert. | 900 |
| 1 | 15 | G.E. | CD-85 | 850 |
| 2 | 15 | G.E. | RC-30 | 850 |
| 1 | 15 | Sprague | D | 700 |
| 1 | 15 | West. | SK | 675/1350 |
| 1 | 15 | West. | SK-100L | 600/2500 |
| 2 | 15 | West. | SK | 500/1500 |
| 1 | 9 | L-A | Baler | 1750 |
| 4 | 10 | G.E. | RC | 1150 |
| 2 | 10 | G.E. | CD-75 | 1150 |
| 1 | 10 | Diehl | | 900 |
| 1 | 10 | G.E. | RC | 29 850 |
| 1 | 10 | G.E. | CD-83 | 850 |
| 1 | 10 | Roth | | 800 |
| 1 | 10 | Diehl | LS-14 | 750 |
| 1 | 10 | West. | Elevator | 700 |
| 1 | 10 | G.E. | CVC | 700 |
| 1 | 10 | West. | SK | 600/1200 |
| 1 | 10 | G.E. | RLC | 500/1500 |
| 1 | 10 | West. | SK | 500/1500 |
| 2 | 10 | G.E. | RF-10 | 400/1600 |
| 2 | 10 | West. | SA | 400/1200 |
| 1 | 10 | West. | SK-90 | 400/1200 |
| 1 | 10 | Diehl | | 200/247 |
| 1 | 7½ | Sturt. | TF | 3600 |
| 1 | 7½ | El. Dyn. | 2S | 1750 |
| 1 | 7½ | G.E. | RC | 1150 |
| 6 | 7½ | West. | SK-40 | 1180 |
| 1 | 7½ | G.E. | CO-1804 | |
| 1 | 8 | L-A | Baler | 1200 |
| 2 | 7½ | West. | SK | 850 |
| 2 | 7½ | G.E. | RC | 850 |
| 1 | 7½ | West. | SK-60 | 850 |
| 2 | 7½ | G.E. | RF-9 | 600/1800 |
| 1 | 7½ | G.E. | RF-10A | 600/1500 |
| 1 | 7½ | West. | SK-90 | 650/1300 |
| 1 | 7½ | El. Dyn. | 3S | 550/1650 |

### 230 Volt D.C. Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 7½ | G.E. | RF-10 | 450/1800 |
| 1 | 7½ | G.E. | RF-10 | 450/1600 |
| 1 | 7½ | G.E. | RF | 450/1800 |
| 2 | 7½ | West. | SK-70 | 400/1600 |
| 1 | 7½ | Al. Ch. | | 350/1050 |
| 1 | 7½ | L-A | Baler | |

### 110 Volt D.C. Motors

| Qu. | H.P. | Make | Type | Speed |
|---|---|---|---|---|
| 1 | 45 | G.E. | RC | 1100 |
| 2 | 10 | Lincoln | I-SC | 3500 |
| 1 | 10 | L-A | | 3500 |
| 1 | 10 | E. Dyn. | 3S | 1100 |
| 1 | 10 | West. | SK-70 | 850 |
| 1 | 10 | Reliance | | 400/1600 |
| 2 | 10 | Diehl | | 230 |
| 1 | 7½ | G.E. | CVC | 725 |
| 1 | 7½ | El. Dyn. | 5S | 450/900 |
| 1 | 7 | El. Dyn. | | 600/1200 |

### D.C. Generators

| KW | Make | Voltage | Ampere | Speed |
|---|---|---|---|---|
| 300 | Burke (2) | 250/125 | 1200 | 900 |
| 300 | West. (2) | 250 | 1200 | 900 |
| 250 | G.E. | 125 | 2000 | 720 |
| 100 | G.E. | 125 | 800 | 1150 |
| 100 | Al. Ch. | 250/125 | 400 | 1150 |
| 50 | G.E. (2) | 125 | 400 | 1150 |
| 50 | G.E. | 250 | 200 | 870 |
| 30 | El. Dyn. | 600 | 50 | 1150 |
| 30 | G.E. | 125 | 240 | 1150 |
| 25 | G.E. | 125 | 200 | 1150 |
| 20 | West. | 250 | 100 | 1150 |
| 10 | West. | 250 | 40 | 1150 |
| 10 | West. | 125 | 80 | 1150 |
| 7½ | G.E. | 250 | 30 | 1150 |
| 7½ | West. | 125 | 60 | 1150 |

### AIR COMPRESSORS

| | |
|---|---|
| 12½"x12" | American |
| 10"x6" | Gardner |
| 9"x8" | Ingersoll Rand |
| 9"x8" | Sullivan |
| 7"x6" | Ingersoll Rand |

**LEEDS & NORTHRUP MICROMAX**

**INDICATING THERMOCOUPLE PYROMETERS**

**Model S Recorders**
**Model C Controllers**
**Model B Recorders**

***Some New— All Others Equal to New***

**D.C. to A.C. Generators 1 to 10 K.V.A. 115 and 230 V.D.C. to 1 ph. and 3 ph. 110-220 & 440 V. A.C.**

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# L. J. LAND & COMPANY

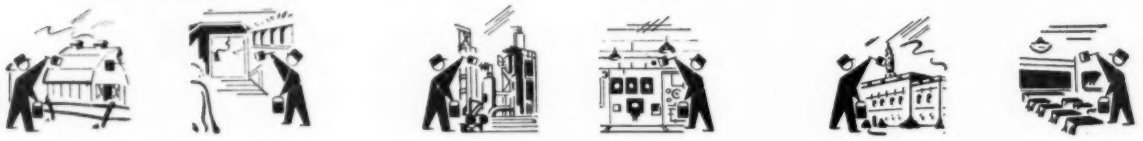
**146 GRAND STREET, NEW YORK 13, NEW YORK**

**Established 1910** **CAnal 6-6976**

# HOW TO DO SPRING PAINTING FOR ONLY 65¢ a gal.*

*This* spring you can get all the paint you need to do those paint jobs put off because of wartime paint restrictions. Furthermore, you can get it at the low cost of only 65¢ per gallon* in types suitable for interiors or exteriors. For example, look at the two types offered for sale in this advertisement. Both are surplus government-owned paints available in enormous quantities and many locations. Write, wire or phone your nearest War Assets Administration Office below or clip and mail the coupon.

*Minimum sale 200 gallons of any one color, F.O.B. location, subject to prior sale. Packaged in 5 gal. containers . . . some in 50 gal. drums.



**EXTERIOR**—*Oil-Type Ready-Mixed Paint T-1215*

This is a medium grade paint which is ready to use and inexpensive. It produces a flat finish when brushed or sprayed on the surface to be protected. It is suitable for the great bulk of exterior maintenance painting. T-1215 may be used also as a first coater or undercoat over previously painted surfaces. T-1215 may be mixed in with linseed oil-white lead or other oil paints to obtain lighter shades or higher gloss. It dries in a few hours. Suggested uses for wood surfaces include buildings, warehouses, fences, garages and barns. Paint may be used on primed tin and galvanized iron roofs and metal buildings; also on brick, masonry and concrete.

**COLORS: Black—Dark Green—Loam (dark slate color)—Olive Drab—Field Drab (gray-brown color)—Earth Yellow (deep buff color)—Earth Brown (smoke brown color).**

**INTERIOR**—*Oleoresinous Emulsifiable Paint T-1279*

This paint is best suited for interior use. It is an oil-in-water emulsion type widely used today. It is thinned for application with water or organic solvents, such as naphtha or mineral spirits. The paint is very easy to brush on and dries to a flat finish, easy to clean; also may be sprayed. Any two colors make an attractive contrasting finish. Dark colors used on lower part of walls hide soiling marks. T-1279 contains a fungicide for mildew prevention. It can be applied on cold, damp surfaces. T-1279 may be mixed in with white or light casein paints to produce lighter shades but not with conventional oil paints. Suggested uses include walls, and ceilings of plaster, composition board, concrete, stucco and brick; also concrete floors.

**COLORS: Light Green—Dark Green—Field Drab (gray-brown color)—Earth Yellow (deep buff color)—Black—Earth Brown (smoke brown color)—Loam (dark slate color)—Sand—Olive Drab—Earth Red (Cinnamon color).**

**VETERANS OF WORLD WAR II**

To help you in purchasing surplus property, a veterans' unit has been established in each War Assets Administration Regional Office.

**To War Assets Administration:**

Please send me, without obligation, information on the following:

Oil-Type Ready-Mixed Paint, T-1215; colors.....

Oleoresinous Emulsifiable Paint, T-1279 colors.....

Name.....Tel No.....

Firm.....

Address.....

City.....State.....

444

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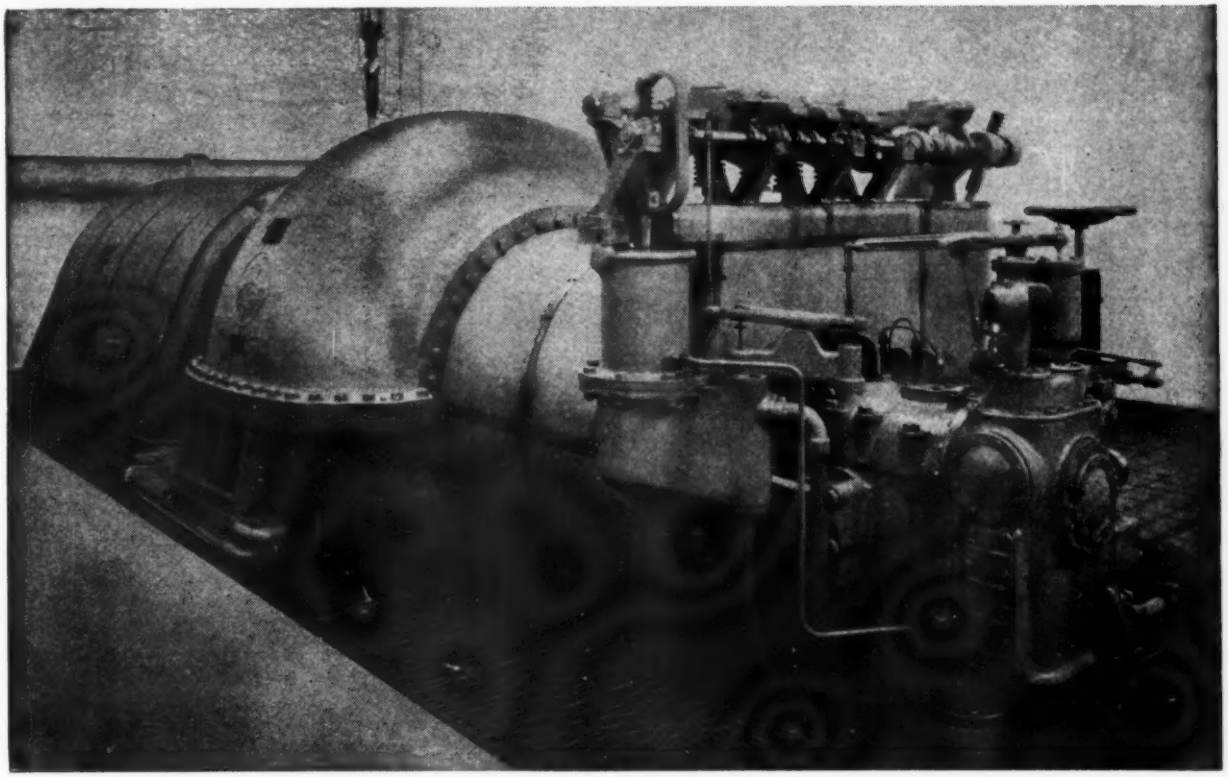
# TURBINE GENERATOR UNITS AVAILABLE IMMEDIATE DELIVERY



**ACTUAL VIEW**

6000 KW General Electric, 13 stage, form EE, type R, 3600 RPM, 200-400 lbs. pressure direct connected to: 7500 KVA—6000 KW 80% P.F. General Electric, type ATB-2, form HT, 3 phase, 60 cycle, 2300/4000 volt, 3600 RPM alternating current generator equipped with a 9000 sq. ft., two-pass Elliott surface condenser with all condensing auxiliaries, 50 KW, 125 volt direct current steam turbine-exciter set, switchboard panels, instruments and oil circuit breaker—a complete installation. Installed new 1928.

4375 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 200# pressure, equipped with condenser and auxiliaries.

3125 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 225# pressure, 500° TT, equipped with condenser, switchboard and instruments.

3125 KVA G.E. condensing 3 phase, 60 cycle, 2300 volt, 3600 RPM, 200# pressure equipped with surface condenser, switchboard.

2500 KVA G.E. 6 stage condensing, 3 phase, 60 cycle, 2300 volts, 1800 RPM, 150-200# pressure, complete with motor driven exciter set, switchboard. Wheeler surface condenser, auxiliaries.

1875 KVA G.E. condensing, 3 phase, 60 cycle, 6600 volts, 3600 RPM, 200#, 500° TT, complete.

1875 KVA Westinghouse condensing, 3 phase, 60 cycle, 480 volts, 3600 RPM, 175–200# pressure, 500° TT, complete with turbine driven exciter set, switchboard, Westinghouse jet condenser and condensing auxiliaries.

1563 KVA Allis non-condensing, 3 phase, 60 cycle, 480 volt, 3600 RPM, 175-200#, 15-30# gauge back pressure complete with switchboard.

1500 KVA (2) General Electric, condensing, 200# pressure, 550 volts, 3600 RPM complete with condensers, exciters, switchboard panels.

1250 KVA Westinghouse condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 200# pressure, equipped with direct connected shaft exciter, condenser, switchboard.

1250 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 480 volts 3600 RPM, 200-250#, 500° TT, 15 lbs. gauge back pressure, complete with switchboard panel.

937 KVA, General Electric, condensing, 3 phase, 60 cycle, 2300 volt, 3600 RPM, 150# pressure equipped with condenser.

625 KVA Westinghouse condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 200# pressure, equipped direct conected shaft exciter, condenser and switchboard.

375 KVA G.E. condensing, 3 phase 60 cycle, 2300 volts, 360 RPM, 150–200# pressure, 100° SH, complete with surface condenser.

375 KVA Allis-Chalmers — Midwest non-condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 125–150# pressure, 0–10# gauge back, complete with switchboard.

125 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 240 volts, 3600 RPM, 175–200# pressure, 0–10 lbs. gauge back pressure with direct connected exciter.

125 KVA G.E. non-condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 150–200# pressure, 10 lbs. gauge back.

100 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 125–200# pressure, 10 lbs. gauge back.

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### M-G SETS

300 KW Gen. Elec. type MPC gen. DC 170 volts 1760 amp. coupled to 450 HP G.E. MPC motor DC 250 V. 1150 RPM (can furnish A.C. drive).

100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage 1-K motor 3-60-2200/4000 V.—1200 RPM.

50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440 V. 1800 RPM.

40 KW Martin rotary converter, input 3/60/220 v., output DC 230 v., with panel.

35 KW Gen. Elec. DLC gen. DC 250 V. to 50 HP AC motor 3-60-220/440 V.

30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1600 RPM, late style 3 brg. unit.

**Others available—special units built to order.**

### D. C. MOTORS

| H.P. | Mfg. | Type | Volts | Speed |
|---|---|---|---|---|
| 450 | Gen. Elec. | MPC | 230 | 1150 |
| 75 | Whse. | 813 | 125 | 475 |
| 75 | Gen. Elec. | DLC | 230 | 400 |
| 60 | Diehl dynamom | R10 | 250 | 500/2000 |
| 50 | G.E. Sprague | LC | 250 | 700 |
| 50 | Whse. | 8A | 230 | 450/1350 |
| 40 | Gen. Elec. | DLC | 230 | 750 |
| 40 | Roth | S | 115 | 850 |
| 40/50 | Reliance (3) b.b. | 310T | 230 | 600/1800 |
| 40 | Whse. | 8K | 230 | 1700 |
| 35 | Whse. | 8K140 | 230 | 675 |
| 30 | Allis Ch. | E100 | 230 | 1800 |
| 30 | Sprague | dynamom | 250 | 800/2000 |
| 25 | Gen. Elec. | DLC | 115 | 750 |
| 25 | Roth | elevator | 230 | 725 |
| 25 | Whse. enclosed | 8K | 230 | 600 |
| 25 | Whse. | 8K | 230 | 950 |
| 25 | Sprague dyna. | LC | 115 | 700/1500 |
| 25 | Gen. Elec. | RC32 | 230 | 800 |
| 22 | Whse. crane | K-6 | 230 | 1050 |
| 20 | Imperial int. dty. | D37 | 230 | 1200 |
| 20 | Gen. Elec. | RF12 | 230 | 400/1200 |
| 20 | Gen. Elec. | DLC | 230 | 500/1500 |

### SQUIRREL CAGE MOTORS

**3 Phase—60 Cycles—220 or 440 Volts**

| Qua. | H.P. | Mfr. | Type | Speed |
|---|---|---|---|---|
| 1 | 200 | F.M. b.b. 2200 v. | H | 1800 |
| 1 | 150 | Gen. Elec. | I-K | 900 |
| 2 | 125 | Whse. 2200 v. | CS | 1800 |
| 1 | 100 | F. Morse b.b. | H | 1800 |
| 1 | 75 | Allis Ch. | AN | 720 |
| 2 | 60 | Gen. Elec. | I-K | 3600 |
| 1 | 60 | Allis Ch. | B | 600 |
| 1 | 60 | Gen. Elec. | I-K | 720 |
| 1 | 50 | Gen. Elec. | I-K | 600 |
| 1 | 50 | Gen. Elec. vertical | KT | 1200 |
| 2 | 50 | Gen. Elec. | I-K | 900 |
| 2 | 40 | Allis Ch. | AN | 1200 |
| 1 | 40 | Gen. Elec. | KT332 | 1200 |
| 1 | 40 | L. Allis TEFC b.b. | JX-445 | 1200 |
| 2 | 40 | Gen. Elec. | KT-336 | 900 |
| 2 | 30 | Diehl New b.b. | IN-365 | 1800 |
| 2 | 30 | Whse. b.b. | C8444 | 1200 |
| 1 | 30 | G.E. TEFC b.b. | KF444 | 1200 |
| 2 | 30 | Allis Ch. | AN | 1200 |
| 3 | 30 | Allis Ch. | AN | 900 |
| 1 | 30 | Howell | SC | 720 |
| 1 | 25 | F. Morse b.b. | Q64 | 3600 |
| 1 | 25 | Whse. New | C8365 | 1800 |
| 1 | 25 | Gen. Elec. | KT322 | 1200 |
| 2 | 25 | Allis Ch. | AN | 900 |
| 2 | 25 | Allis Ch. | AN | 1200 |
| 2 | 20 | Diehl New b.b. | IN364 | 1800 |
| 1 | 20 | Whse. b.b. | CS | 1200 |
| 4 | 20 | Allis Ch. | AN | 900 |
| 2 | 20 | Gen. Elec. | I-K | 1200 |
| 1 | 20 | Ideal | AA | 1200 |

### 25 CYCLE MOTORS

| H.P. | Mfg. | Type | Speed |
|---|---|---|---|
| 450 | Whse. 2200 v. | CW sl. rg. | 750 |
| 150 | Whse. | HD sl. rg. | 500 |
| 150 | Gen. Elec. 2200 v. | MT359 sl.rg. | 1500 |
| 100 | Whse. | CCL sq. cg. | 500 |
| 100 | Gen. Elec. | I-K sq. cg. | 500 |
| 50 | Allis Ch. | ANY sl. rg. | 1500 |

### SYNCHRONOUS MOTORS

| H.P. | Mfg. | Type | Volts | Speed |
|---|---|---|---|---|
| 750 | Allis Ch. | | 220/440 | 1200 |
| 350 | Gen. Elec. 3 brg. | ATB | 220/440 | 600 |
| 300 | Whse. | ped. | 220/440 | 900 |
| 290 | Gen. Elec. | ATI | 220/440 | 600 |
| 250 | Gen. Elec. | ATI | 220/440 | 514 |
| 250 | Gen. Elec. 1 brg. | ATI | 220/440 | 600 |
| 150 | Gen. Elec. | ATI | 220/440 | 900 |
| 75 | Ideal | SMS | 220/440 | 1200 |
| 40 | Gen. Elec. 8 PF | TS | 220/440 | 900 |

### CENTRIFUGAL PUMPS

**8" Alberger, 2000 gpm @ 80 ft.**
**6" Platt, 1000 gpm @ 230 ft.**
**8" Worthington, 2000 gpm @ 200 ft.**

### SLIP RING MOTORS

**3 Phase—60 Cycles—220 or 440 Volts**

| Qua. | H.P. | Mfg. | Type | Speed |
|---|---|---|---|---|
| 1 | 350 | Whse. 2200 v. | CW | 720 |
| 1 | 300 | Burke | EMV | 225 |
| 1 | 300 | Whse. | HF | 400 |
| 1 | 300 | Gen. Elec. | I-P | 720 |
| 1 | 250 | Gen. Elec. | I-M | 600 |
| 1 | 200 | Gen. Elec. | I-M | 600 |
| 1 | 150 | Gen. Elec. 2200 v. | MT | 1200 |
| 1 | 100 | Gen. Elec. 2200 v. | I-E13A | 1800 |
| 1 | 100 | Gen. Elec. | I-M | 900 |
| 1 | 75 | Gen. Elec. | I-M | 514 |
| 1 | 75 | Gen. Elec. | MT537 | 1800 |
| 1 | 75 | Gen. Elec. 2200 v. | I-E13 | 1800 |
| 1 | 65 | P. & H. b.b. Int. | CA16 | 900 |
| 1 | 60 | Whse. 2200 v. | CW657 | 1800 |
| 1 | 50 | Gen. Elec. | MT536 | 1200 |
| 1 | 60 | Gen. Elec. | MT536 | 1200 |
| 1 | 50 | Gen. Elec. | I-M | 600 |
| 1 | 40 | Gen. Elec. 2 ph. | MQ536 | 900 |
| 1 | 40 | North'n | HW35A | 1200 |
| 2 | 40 | Gen. Elec. | MT532 | 1200 |
| 1 | 40 | Fair Morse b.b. | HV | 1200 |
| 1 | 40 | Whse. | CW | 900 |
| 2 | 40 | Gen. Elec. | M546 | 514 |
| 2 | 40 | Allis Ch. | ANY | 450 |
| 1 | 40 | G.E. 550 v. | MT536 | 900 |
| 1 | 35 | Fair. Morse b.b. | HV | 1800 |

### D. C. GENERATORS

| KW | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | Gen. Elec. 1 brg. | MPC | 125/170 | 1150 |
| 150 | Gen. Elec. | MP | 250 | 600 |
| 75 | Whse | 8 | 125 | 600 |
| 60 | Gen. Elec. | DLC | 250 | 450 |
| 50 | Cr. Wheeler | CC | 125 | 1800 |
| 50 | J&L | cpd. | 250 | 750 |
| 35 | Gen. Elec. | DLC | 250 | 900 |
| 30 | Gen. Elec. | CD113 | 250/125 | 900 |
| 30 | Lincoln b.b. 600 amp. | | 50 | 1200 |
| 25 | Gen. Elec. | DLC | 125 | 900 |
| 25 | Gen. Elec. | RC | 250 | 900 |
| 20 | Allis Ch. (2) | | 125 | 475 |
| 16 | Cr. Wheeler | CCD | 125 | 415 |

**ALSO IN STOCK . . . OIL SWITCHES**
**BLOWER & FANS . . . SPEED REDUCERS . . . 500 NEW MOTORS**

### 60 CYCLE A.C. GENERATORS

| KVA | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 500 | Gen. Elec. 3 brg. | ATB | 2300 | 450 |
| 300 | Gen. Elec. 3 brg. | ATB | 240/480 | 600 |
| 300 | Whse. | ped. | 240/480 | 900 |
| 300 | Elec. Machy. 3 brg. | | 240/480 | 720 |
| 250 | Gen. Elec. 1 brg. | ATB | 240/480 | 600 |
| 150 | Gen. Elec. | ATB | 240/480 | 900 |
| 150 | Allis Ch. | | 2300 | 900 |
| 150 | Allis Ch. 25 cycle | | 240/480 | 500 |
| 100 | Cr. Wheeler | ped. | 240/480 | 600 |
| 50 | Cr. Wheeler | | 240/480 | 1200 |

## ARTHUR WAGNER COMPANY

**1436-38 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 7409**

## ELECTRICAL EQUIPMENT

**REBUILT AND GUARANTEED—PROMPT SHIPMENT**

**MOTORS-GENERATORS-MG SETS-TRANSFORMERS-CONTROLS**

### SPECIAL OFFERINGS

**VARIABLE VOLTAGE DRIVES**

10—40 HP, General Electric Variable Voltage Ward Leonard Drives consisting of:

1—40 KW, 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators with exciters.

1—40 HP, 250/1500 RPM, Type CD-1441 DC Motor.

2—Auxiliary, 5 HP, 1750 RPM Type B-284, DC Motors.

1—Enclosed magnetic control providing jog forward, jog reverse, run, fast, slow, and stop. Complete with motor operated field rheostat.

**NEW G.E. SPLASHPROOF AC MOTORS**
**50°C., 50 Cycle, 220/380 Volts**

| Quantity | HP | Speed | Type |
|---|---|---|---|
| 28 | 3 | 1410 | K-225 |
| 6 | 3 | 1400 | K-225 with motor mounted disc brake |

**NEW 500 VOLT ADJUSTABLE SPEED D.C. MOTORS**

| Qu. | H.P. | Speed | Make | Type |
|---|---|---|---|---|
| 4 | 7½ | 450/1800 | G.E. | CD-85 (1 Hr.) |
| 4 | 60 | 400/1600 | G.E. | CD-1446-AL (1 Hr.) |

**NEW** 25—Allis-Chalmers, 10 H.P., 1200 RPM, 230 Volt, D.C., EB-80, Dripproof, 40°, Ball Bearing.

**NEW** 1—200 HP, 2960 RPM, 3 phase, 50 cycle, 500 Volt, Westinghouse Type CS-8120 TEFC
2—700 HP, 1484, RPM, 3 phase, 50 cycle, 6300 Volt, Westinghouse Type CS-4-39D-12

## ELECTRIC GENERATOR & MOTOR CO.

**4521 HAMILTON AVE. — CLEVELAND, 14, OHIO**

**Phone: ENdicott 5656 — Established 1900**

### SYNCH. CONVERTERS

500 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
:00 KW G.E. 600 D.C. 2300/4000 A.C. RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

### MOTOR GENERATORS

300 KW G.E. SYN 600 V. 2300/4000 A.C. 1200 RPM
300 KW G.E. SYN. 250 V. 2300/4000 A.C. 1200 RPM
150 KW G.E. SYN. 250 V. 2300/4000 A.C. 900 RPM
150 KW WEST. SYN. 600 V. 2300/4000 AC. 1200 RPM

**Each unit listed above is owned by us and is available now for immediate purchase**

## WALLACE E. KIRK CO.

**Incorporated**

**502 Grant Building, Pittsburgh, Pa.**

## TRANSFORMERS

**New or used. All types and sizes. Air and oil cooled. Phase changers a specialty.**

**ATLANTIC TRANSFORMER CO.**
*Transformer Specialists*
**5143 N. 2nd St. — Phila., Pa.**

# THE PICK OF POWER EQUIPMENT

### TURBINE UNITS—60 Cy.

1—22500 KW General Electric Cond.
1—15300 KVA Westinghouse Cond.
1— 7500 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 3750 KVA Westinghouse Extrac.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Extrac.
1— 937 KVA General Electric Cond.
1— 375 KVA General Electric Cond.
1— 6250 KVA Allis Chalmers Topping

### D. C. TURBO UNITS

1—250 KW Westinghouse, 120/240 V.
1—125 KW General Electric, 125 V.
1— 75 KW General Electric, 125 V.
1— 50 KW Westinghouse, 125 V.

### STEAM ENGINE UNITS—60 Cy.

1—625 KVA Ames Uniflow
2—480 KVA Skinner Uniflow
1—375 KVA Harrisburg Uniflow
1—325 KVA Skinner Uniflow
1—300 KVA Skinner Un flow
1—150 KVA Ames Uniflow

### D. C. STEAM ENGINE UNITS

1—500 KW Ames Uniflow 125 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—250 KW Ames Uniflow 250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire.

### DIESEL ENGINE UNITS

1—625 HP Worthington, 240 V. 60 cy. gen.
2—450 HP Worthington, 2300 V. 60 cy. gen.
1—440 HP Nordberg, 250 V. DC gen.
2—410 HP DeLaVergne, 4000 V. 60 cy. gen.
2—400 HP LeRoi RXISV (gasoline)eng. only.
1—375 HP McInt. & Sey., 240 V. 60 cy. gen.
1—300 HP McInt. & Sey., 480 V. 60 cy. gen.
1—270 HP DeLaVergne, 4000 V. 60 cy. gen.
1—150 HP Buckeye 400 RPM engine only.
2—125 HP Winton, 240 V. 60 cy. gen.

### WATER TUBE BOILERS

2—1373 HP B. & W. 230-lb., Oil Fired
1—1320 HP Springfield 400-lb., Pulverizer
2— 760 HP Stirling 250-lb., Stokers
2— 617 HP Wickes 250-lb., Bent Tube
1— 607 HP Wickes 250-lb., Stoker
6—600 HP B. & W. 200-lb., Stokers
2— 600 HP Springfield 200-lb., Stokers
2— 560 HP Erie City 460-lb.
5— 492 HP Heine 180-lb., Stokers
2— 481 HP Springfield 225-lb., Pulverizer
2— 405 HP Erie City 160-lb., Stokers

### SYNCHRONOUS MOTORS

1—600 HP G. E. 60 cy. 2200 V. 600 RPM
1—500 HP Al. Ch. 60 cy. 2300 V. 450 RPM
1—375 HP G. E. 60 cy. 2300 V. 1800 RPM
2—250 HP G. E. 60 cy. 2200 V. 225 RPM
1—200 HP Ideal 60 cy. 4000 V. 514 RPM
1—100 HP G. E. 60 cy. 2300 V. 240 RPM (Super)
2—100 HP E. M. 60 cy. 440 V. 1200 RPM

### INDUCTION MOTORS—60 Cy.

1—1000 HP West. slip ring 2200 V. 360 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
1— 200 HP Burke sq. cage 440 V. 575 RPM
2— 100 HP G.E. sq. cage 440 V. 720 RPM
2— 100 HP West. sq. cage 220/440 V. 1800 RPM

### MOTOR GEN. SETS—60 Cy.

1—1000 KW General Electric 600 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 150 KW General Electric 125 V. DC
1— 100 KW Westinghouse 125 V.
1— 100 KW Burke 250 V. DC
1— 75 KW General Electric 125 V. DC
1— 50 KW Westinghouse 250 V. DC

### ROTARIES—60 Cy.

2—2600 KW General Electric 300 V.
1—2000 KW General Electric 600 V.
2—1750 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
1— 500 KW General Electric 250 V.

### FREQUENCY CHANGERS

1—2150 KVA G. E. 25/62½ cy. 750 RPM
1—1875 KVA G. E. 25/60 cy. 300 RPM
2—1500 KW West. 25/60 cy. 300 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1—1000 KVA Al. Ch. 25/62½ cy. 375 RPM
1— 938 KVA West. 25/62½ cy. 750 RPM
1— 750 KVA G.E. 60/25 cy. 300 RPM

### TRANSFORMERS—1 Ph. 60 Cy.

4— 6667 KVA G. E. 79660/138,000-34,500 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 750 KVA Pitts. 66000-33000 V.
3— 100 KVA G. E. 66000-6900/11000 V.
1— 7500 KVA West. 33000-13800 V. 3 ph.
3— 150 KVA G. E. 33000-2300 V.
6— 100 KVA G. E. 33000-2300 V.
40— 50 KVA G. E. 33000-2400 V. New
50— 25 KVA G. E. 33000-2400 V. New
2—10000 KVA West. 26400-4560 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
2— 1000 KVA G. E. 23000/11500-575 V.
1—16000 KVA West. 13200-4560 V. 3 ph.
1— 3000 KVA G. E. 13200-480 V. 3 ph.
3— 600 KVA Moloney 13200-2200 V.
3— 200 KVA G. E. 13200-480 V. Pyranol
3— 100 KVA West. 13200-2300 V.
2— 1000 KVA G. E. 11500/23000-575 V.
1— 2000 KVA G. E. 6600-2300, 3-P. Master Sub.
3— 150 KVA G. E. 4150-220 V. 3 ph.
2— 1500 KVA Al. Ch. 2400-480 V. 3 ph.
3— 250 KVA Al. Ch. 2300-230/460 V.

### OIL CIRCUIT BREAKERS

1— 400 A. 37 KV G. E. FK0136 Outdoor
2—1000 A. 30 KV Kelman CB76 "
1— 400 A. 25 KV G. E. FK0136 "
4— 600 A. 15 KV G. E. FHK0139-24BS "
2— 600 A. 15 KV G.E. FK037 "
1— 600 A. 15 KV West. 0-221 "
2— 400 A. 15 KV G. E. FHK0136 "

*PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT*

# BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, New York

## TURBO GENERATORS

**750 KW., 3 ph., 60 cy., 480V. 3600 Allis Chalmers to a Moore extraction type Turbine with board.**

**500 KW., 3 ph., 60 cy., 480V. Westgh. non cond. Turbo Generator with board.**

**937 KVA., 3 ph., 60 cy., 2300V. Gen. Elec. cond. Turbo Generator.**

## ROTARY CONVERTER

**1—1500 KW., 250 V. Westgh. complete.**

**1—156 KVA., 3 ph., 60 cy., 240 volt Gen. Elec. to an 8 cylinder Buffalo engine only 5 years old, little used.**

**The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries.**

***What have you for sale?***

## KEYSTONE

**Power Plant Equipment Company**

**8403 Hegermen St., Phila. 36, Penna.**

# POWER PLANT EQUIPMENT

*Special Offerings*

### TURBO-GENERATORS

1—3000 KW. 2300 V. Cond.
1—2500 KW. 2300 V. Cond.
1—1250 KW. 2300 V. Cond.
1— 250 KW. 240 V. N. C.
1—2000 KW. 600 V. Cond.
1—1500 KW. 2300 V. Cond.
1— 750 KW. 2300 V. Cond.
1— 500 KW. 440 V. N. C.
1— 500 KW. 125 V. D.C.
1—375 KW. 440 V. Cond.
1— 120 KW. 440 V. N. C.

### ENGINE GENERATORS

1—540 KW. Uniflow 480 V.
1—150 KW. 480 V.
1—600 H.P. Uniflow Eng.
1—168 KW. 550 V.
2—280 KW. 440 V.
1—600 KW. 2300 V.

### TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#
1—100 H.P. G. E. with gears

### BOILERS

1— 990 H.P. 200# Coal
1— 825 H.P. 175# Coal
1—1390 H.P. 400# Coal
2— 480 H.P. 225# Coal
1— 360 H.P. 190# Coal
2— 300 H.P. 250# Coal
1— 260 H.P. 200# Coal
2— 175 H.P. 200# Coal

### MOTOR

1—1250 H.P. G.E. Syn. Engine Type 2300 V.

### AIR COMPRESSORS

1—6700 C. F. 22# Turbine Driven
1—1600 C.F. 50# Steam
1—3000 C.F. 125# Motor
1—1570 C.F. 100# Motor
1—1247 C.F. 55# Motor
1—1214 C.F. 100# Motor
1— 600 C.F. 350# Steam

### FORCED DRAFT FANS

2—Coppus 28"—15000 CFM at 4" S.P. Turbine Driven New, never used

8—Coppus 26"—11500 CFM at 4" S.P. Turbine Driven condition—good.

***Write or wire for additional data and prints.***

## A. LEE ELLIS CO., U. S. Mchy. Bldg., Boston, Mass.

**The Buyer Must Be Satisfied—Always**

# MOTORS • GENERATORS • TRANSFORMERS

### MOTORS
**3 phase, 25 cycle, 220/440 Volts**

| HP | Make | Type | Frame | RPM |
|---|---|---|---|---|
| 1 | Gen. Elect. | K | 224 | 1450 |
| 1 | Westinghouse | CS | 224 | 1425 |
| 1 | Robbins-Myers | H | Ball Bearing | 1425 |
| 1 | Gen. Elect. | KT | 926 | 1345 |
| 1 | Louis Allis | ES | Ball Bearing | 1430 |
| 2 | Gen. Elect | KT | 731 | 750 |
| 2 | Brown & Brockmyer | | Enclosed | 1450 |
| 2 | Gen. Elect. | KT | 934 | 1450 |
| 2 | Gen. Elect. | KT | 140 | 1450 |
| 2(3) | Reliance | Enclosed | Ball Bearing | 750 |
| 2(5) | Westinghouse | T.E.F.C.B.B. | 284 | 500 |
| 2(3) | Reliance | Ball Bearing | 15AA | 750 |
| 3 | Westinghouse | CS | 284 | 750 |
| 3 | Allis Chalmers | | | 710 |
| 3 | Gen. Elect. | KT | 180 | 710 |
| 3 | Westinghouse | CS | 354A | 715 |
| 3 | Wagner | LBP | | 1420 |
| 3(5) | Gen. Elect. | KT | 944 | 1500 |
| 3(2) | Cr. Wheeler | T.E.F.C.B.B. | 284 | 750 |
| 3 | Cr. Wheeler | SC | | 1500 |
| 3 | Reliance | Ball Bearing | | 750 |
| 5 | Gen. Elect. | KT | 180 | 1500 |
| 5 | Gen. Elect. | K | 284 | 1450 |
| 5 | Gen. Elect. | KT | 181 | 750 |
| 5 | Reliance | Ball Bearing | 44AA | 750 |
| 7½ | Lincoln | B. B. | D111 | 1500 |
| 7½ | Howell | B. B. R. | 326 | 1500 |
| 7½ | Ger. Elect. | KF | | 1450 |
| 7½(2) | Gen. Elect. | KT | 181 | 1450 |
| 7½ | Century | ARS | | 1450 |
| 7½ | Wagner | | | 750 |
| 10(7) | Wagner | 19TBM | | 710 |
| 10 | Westinghouse | CS | | 710 |
| 10 | Reliance | | | 750 |
| 10(2) | Gen. Elect. | KT | 312 | 750 |
| 10(5) | Gen. Elect. | KT | 512 | 750 |
| 10(3) | Westinghouse | Enclosed | Gear Head | 1500/378 |
| 15 | Gen. Elect | KT | 327 | 750 |
| 15 | Westinghouse | MS | | 750 |
| 15(3) | Westinghouse | CCL | | 750 |
| 15 | Westinghouse | CCL | | 1500 |
| 15 | Master | Enclosed | Gear Head | 1500/416 |
| 20 | Westinghouse | CS | | 730 |
| 20(3) | Westinghouse | CCL | | 750 |
| 20 | Wagner | BP22T | | 750 |
| 25 | Gen. Elect. | I | Form K | 750 |
| 30 | Burke | | | 750 |
| 30 | Gen. Elect. | I | Form K | 750 |
| 30 | Wagner | | | 750 |
| 40 | Wagner | 22TLBP | | 1500 |
| 40 | Gen. Elect. | KT | 347 | 750 |
| 50 | Gen. Elect. | I | Form K | 750 |
| 75(4) | Gen. Elect. | I | Form K | 500 |
| 75(2) | Gen. Elect. | KT | 557 | 750 |
| 75 | Westinghouse | CS | | 750 |
| 100 | Westinghouse | CCL | | 500 |
| 150 | Gen. Elect. | I | Form K | 375 |
| 150 | Gen. Elect. | KT | 568 | 375 |
| 150 | Gen. Elect. | KT | 557Y (2200 v.) | 1470 |
| 200 | Gen. Elect. | I | Form K | 500 |
| 225 | Elect. Mach. | Synch. | (2200 v.) | 500 |

### TRANSFORMERS

3— 75 KVA Niagara. New. OISC 60/1/2400/120/240.
6—100 KVA Niagara. New. OISC 60/1/2400/120/240.
3—150 KVA Westinghouse OISC 25/1/2300/460.
3—200 KVA Westingnouse OISC 25/1/2300/460.
3—500 KVA Pittsburgh OISC 25/1/2300/230/460.

### MOTORS
**3 phase, 60 cycle, 220/440 Volts**

| HP | Make | Type | RPM | Serial No. |
|---|---|---|---|---|
| 15 | Westinghouse | CS | 1200 | 1883285 |
| 15 | Westinghouse | MS | 1200 | 9445931 |
| 20 | Westinghouse | CS | 1200 | 2160500 |
| 20 | Westinghouse | MS | 1200 | 1050826 |
| 20 | Westinghouse | CS | 1800 | 1863526 |
| 20 | Westinghouse | CS | 1800 | 2950044 |
| 25 | Westinghouse | MS | 1800 | 1562026 |
| 25 | Westinghouse | MS | 1800 | 1334763 |
| 25 | Westinghouse | CS | 1200 | 2286768 |
| 25 | Westinghouse | MS | 1200 | 1197673 |
| 25 | Wagner | BP | 1200 | 126906 |
| 30 | Westinghouse | MS | 1200 | 1197674 |
| 30 | Fairbanks-Morse | V-H-10D | 1800 | 43476 |
| 40 | Westinghouse | CS | 900 | 1896969 |
| 40 | General Electric | I-K | 1800 | 73318 |
| 40 | Westinghouse | MS | 1800 | 1506800 |
| 40 | General Electric | I-K | 1200 | 181444 |
| 40 | Westinghouse | MS | 1200 | 1027421 |
| 50 | Westinghouse | MS | 1800 | 1289389 |
| 50 | Westinghouse | MS | 1200 | 854410 |
| 50 | Westinghouse | CS | 1800 | 2691183 |
| 50 | General Electric | 14 | 1800 | 181444 |
| 50 | General Electric | KT-352 | 720 | |
| 50 | Allis Chalmers | | 1800 | 3K28825 |
| 60 | Reliance | | 1200 | B11458 |
| 60 | General Electric | I | 1800 | 292596 |
| 60 | Westinghouse | CCL | 1800 | 329654 |
| 60 | Robbins-Myers | K | 1800 | P515362 |
| 60 | Triumph | | 1800 | C14248 |
| 60 | Westinghouse | CCL | 1200 | 854121 (2200 v.) |
| 100 | Westinghouse | CCL | 1800 | 1043213 |
| 100 | Westinghouse | CCL | 1800 | 765231 (2200 v.) |
| 125 | Westinghouse | CS | 1200 | 2318625 |
| 150 | Westinghouse | CS | 1800 | 2429726 |
| 150 | Westinghouse | CCL | 900 | 438385 |
| 150 | Westinghouse | CS | 1200 | 4572596 (2200 v.) |
| 150 | General Electric | I-K | 1200 | |
| 150 | Westinghouse | CCL | 720 | 808349 (2200 v.) |
| 200 | General Electric | I-K | 900 | 232917 (2200 v.) |
| 200 | Westinghouse | CCL | 900 | 919537 (2200 v.) |
| 250 | General Electric | I-K | 600 | 2246834 |
| 300 | General Electric | I-K | 720 | 2357743 |
| 400 | General Electric | I-K | 900 | 2347845 |

### SLIP RING MOTORS
**3 phase, 60 cycle, 220/440 Volts**

| HP | Make | Type | RPM | Serial No. |
|---|---|---|---|---|
| 20 | Westinghouse | CW644C | 675 | 8009992 |
| 20 | General Electric | MT332 | 545 | 3889010 |
| 30 | Westinghouse | HF | 1745 | 4558408 |
| 40 | Westinghouse | CW748 | 690 | 4406823 |
| 250 | Allis Chalmers | 3 bearing | 505 | 104390 (2300 v.) |
| 400 | General Electric | I-M | 900 | 224674 |
| 400 | General Electric | I-M | 900 | 246762 |

### MAGNETIC CONTACTOR

400 HP. Gen. Elec. Type CR 7006. Form D12D. 3/60/440 Volts.

### 25 CYCLE GEARHEAD MOTORS

3—10 HP. Westinghouse Frame. 284. Enclosed 1500/378 RPM.
15 HP. Master Frame 405 Enclosed 1400/416 RPM.

### WELDERS

1—300 AMP. Lincoln Shield Arc—60 cycle.
1—400 AMP. Lincoln Shield Arc—25 cycle.

### SPECIAL

5—5 HP. Westinghouse Motors Nema Frame CSW. 284—Totally Enc., Fan Cooled Ball Bearing 3/60/220/440 volts, 1200 RPM.

### FREQUENCY CHANGER

450 KVA. Westinghouse Synch. Generator, 25 cycle, 3 phase, 440 volts, 720 RPM., direct connected to 850 HP. West. Synch. Motor 60 cycle, 3 phase, 4160 volts, 720 RPM. With starting equipment and panels.

**ERIE ELECTRIC CO., INC.** 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

## DIRECT CURRENT MOTORS
**230 volt**

| | | | | |
|---|---|---|---|---|
| 15 | 7½ HP | C. W. | CCM | 875 RPM |
| 4 | 10 HP | G. E. | RC | 850 RPM |
| 3 | 15 HP | G. E. | RC | 1150 RPM |
| 5 | 15 HP | G. E. | RC | 800 RPM |
| 2 | 15 HP | West. | SK | 675 RPM |
| 2 | 25 HP | G. E. | RC | 1150 RPM |
| 5 | 2 HP | G. E. | RLC | 415/830 RPM |
| 1 | 10 HP | G. E. | RF | 600/1800 RPM |

## PUMPS

| | | | Head | RPM |
|---|---|---|---|---|
| 5 | 4″ Gould | 270 GPM | 30 Ft | 900 |
| 4 | 4″ LeCourtney | 300 GPM | 105 Ft | 1750 |
| 1 | 14″ Cameron | 5000 GPM | 25 Ft | 720 |
| 1 | 16″ Cameron | 8500 GPM | 45 Ft | 720 |
| 1 | 8″ Union | 1240 GPM | 300 Ft | 1750 |
| 2 | 10″ Ingersoll-Rand | 500 GPM | 360 Ft | 1750 |

## TURBO-GENERATORS — MOTORS — GENERATORS

1—Treadwell Single Drum Mine Hoist, direct driven by 200 HP Westinghouse MCOA, 230 Volt, DC motor

1—20-ton Alfred Box Crane, hand operated, 39 ft. span

1—20-ton G.E. Locomotive, 500 V DC

1—5000 KW Westinghouse Turbo-Generator, 3600 RPM, 200# press. condensing, 2300/60/3 complete.

1—800 KW Westinghouse M-G set, syn. motor, 1150 HP, 514 RPM, 13200/60/3. Generator 250 V DC with direct connected exciter.

1—50 KW Westinghouse M-G Set, 1200 RPM, 75 HP motor, 2200/60/3. Generator 125 volt DC

1—50 KW Westinghouse Turbo-Generator, 200# press. 75 HP, 7200 RPM, geared to 50 KW, 125 V DC, 1200 RPM

1—700 HP G.E. Type KF motor, 2300/60/3 1800 RPM

1—1000 HP G.E. Slip Ring motor, 6600/60/3, 600 RPM, with controls

1—150 KW G.E. Alternator, Type ATB, Form B, .8 PF, 480/60/3 600 RPM, 3 bearing, direct connected exciter

1—300 KVA Generator set, Burke alternator, 480/60/3, 200 RPM, direct connected to Exciter and Skinner Uniflow, 150#, ISP, O-5# BP

1—3600 sq. ft. Wheeler Surface Condenser

2—12″ Lecourtney Centrifugal, bronze fitted Pumps, 1800 RPM

1—Terry Turbine, 710 HP, 3600 RPM, 145# ISP, O-60# BP, 18″ x 18″ centrifugal pump rated 13,000 GPM, 170′ head, 1000 RPM

**Heat and Power**
COMPANY
45 BOND ST. • ALGONQUIN 4-3874 • NEW YORK 12, N. Y.

# REBUILT POWER EQUIPMENT

READY TO SHIP!

### SLIPRING MOTORS—3 PH., 60 Cy.

| H.P. | Make | Volts | R.P.M. | Type |
|---|---|---|---|---|
| 400 | Westg. | 2200 | 435 | CW |
| 260 | Burke | 440 | 600 | EMY-65 |
| 200 | G.E. | 220/440 | 1200 | M-1 |
| 150 | G.E. | 220/440 | 1200 | M-1 |
| 50/60 | Westg. | 220 | 1800 | CW |
| 50 | Chandeys'n | 220/440 | 1800 | |
| 30 | Westg. | 220 | 1160 | CW |
| 20 | Westg. | 220 | 575 | CW |

### ALTERNATING CURRENT MOTORS

3 ph. 60 cy.

| H.P. | Make | Volts | R.P.M. | Type |
|---|---|---|---|---|
| 150 | Wagner | 440 | 1800 | 31V |
| 100 | Triumph | 220/440 | 850 | B-15 |
| 100 | G.E. | 220 | 17.5 | I |
| 100 | Westg. | 440 | 1160 | CS |
| 75 | Westg. | 440 | 900 | CS |
| 75 | West. | 220/440 | 1800 | MS |
| 75 | Triumph | 220/440 | 685 | B-15 |
| 60 | West. | 220/440 | 1800 | CS |
| 60 | West. | 220/440 | 1800 | C.S-T.E. |
| 60 | G.E. | 220 | 720 | KT |
| 60 | G.E. | 220 | 600 | KT |
| 50/32 | G.E. | 440 | 800/640 | |
| 50 | Chandeys'n | 220/440 | 1800 | |
| 50 | G.E. | 220 | 515 | KT |
| 50 | Westg. | 440 | 1200 | CS |
| 40 | G.E. | 220 | 430 | KT |
| 40 | Westg. | 440 | 870 | CS |
| 40 | Westg. | 440 | 1170 | CS |
| 40 | Westg. | 220/440 | 1800 | CS |
| 25 | G.E. | 220/440 | 1800 | KT |

### VARIABLE SPEED MOTORS—230 VOLT D.C.

| H.P. | Make | R.P.M. | Type |
|---|---|---|---|
| 100 | West. | 300/900 | SK-191 |
| 100 | Westg. | 175/300/700 | SK |
| 25 | Westg. | 600/1200 | SK |
| 20 | Westg. | 500/1500 | SA |
| 20 | West. | 750/1500 | SK-110L |
| 20 | West. | 625/1250 | SA-6 |
| 15 | Reliance | 500/1800 | |
| 15 | Westg. | 875/1600 | SA |
| 15 | Westg. | 825/1650 | SK |
| 13 | Westg. | 500/1000 | S-7 |
| 10 | G.E. | 625/1250 | LC |
| 10 | Westg. | 565/1130 | S-6 |
| 10 | Westg. | 400/1600 | SA |
| 7½ | Westg. | 450/1800 | SK |
| 7 | Westg. | 660/1050 | S |
| 5 | West. | 400/800 | SK-80 |
| 4 | G.E. | 850/1700 | LC-8 |
| 3 | G.E. | 400/1200 | RLC-114 |
| 3 | Roth | 500/1000 | RS |

### SERIES WOUND MOTORS

| H.P. | Make | Volts | R.P.M. | Type |
|---|---|---|---|---|
| 175 | G.E. | 230 | 475 | MD |
| 140 | G.E. | 230 | 410 | MD |
| 80 | G.E. | 230 | 500 | MD-107 |
| 80 | West. | 230 | 490 | 76-A |
| 50 | G.E. | 230 | 550 | MD-106 |
| 50 | Cr. Wh. | 230 | 500 | SM |
| 35 | Westg. | 230 | 550 | 49D |
| 32 | G.E. | 230 | 450 | 801 |
| 32 | Shaw | 230 | 485 | 5L2E |
| 28 | Westg. | 230 | 395 | 904 |
| 25 | West. | 230 | 600 | MT |
| 15 | West. | 220 | 650 | |
| 10 | Otis | 230 | 1000 | |
| 15 | Cr. Wh. | 220 | 270 | SM |
| 10 | West. | 230 | 650 | MT-00 |
| 7.5 | Westg. | 230 | 1100 | MC |

### 230 VOLT DC MOTORS

| H.P. | Make | R.P.M. | Type |
|---|---|---|---|
| 100 | West. | 300 | SK |
| 85 | West. | 500 | M |
| 80 | G.E. | 500 | MD107 |
| 75 | G.E. | 600 | MP |
| 75 | West. | 440 | |
| 30 | G.E. | 1100 | ELC |
| 25 | Westg. | 600 | SK |
| 20 | Western Elec. | 1000 | E-40-M |

### TRANSFORMERS

1 ph. 60 Cy.

| No | Kva. | Pri. | Sec. | Make |
|---|---|---|---|---|
| 3 | 250 | 2300 | 460/230 | Allis Chal. |
| 3 | 250 | 6600/5940 | 2300 | West. |
| 2 | 150 | 2200/2300/2400 | 220/230/240 | G.E. |
| 3 | 125 | 2200 | 220/440 | G.E. |
| 3 | 112 | 5/2400 | 240/480 | G.E. |
| 3 | 100 | 2400 | 240/480 | Allis Chal. |
| 3 | 5 | 2300 | 220/440 | G.E. |
| 3 | 75 | 2400/4160Y | 240/480 | Allis Chal. |
| 1 | 75 | 2400/4160Y | 120/240 | West. |
| 4 | 75 | 2400 | 240/480 | G.E. |
| 3 | 75 | 240/4000Y | 120/240 | Allis Chal. |
| 1 | 75 | 2400 | 240/480 | G.E. |
| 2 | 50 | 2200/1100 | 220/110 | Maloney |
| 2 | 50 | 2200 | 110/220 | Packard |
| 1 | 40 | 2300/115C | 113/230 | Maloney |
| 1 | 40 | 1100/2200 | 110/220 | Pittsburgh |
| 3 | 40 | 2300/1100 | 220/110 | West. |
| 9 | 37½ | 2400 | 480/240 | G.E. |
| 1 | 25 | 2300 | 110/220 | West. |
| 2 | 20 | 2300/110 | 440/220/110 | West. |
| 1 | 20 | 2300 | 110/230 | West. |
| 2 | 20 | 1150/2300 | 115/230 | Maloney |
| 6 | 18 | 220 | 19½/38½ | El. Furnace |
| 3 | 15 | 2200 | 110/220 | Cr. Wh. |
| 3 | 15 | 2200 | 110/220 | Packard |
| 21 | 15 | 2200/1100 | 440/220/110 | West. |
| 58 | 7½ | 2200 | 110/220 | G.E. & West |
| 9 | 5 | 2200 | 110/220 | G.E. & West |

### D.C. CLARK CONTROLLER

1—250 HP Clark Vari Time magneto controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

### MOTOR GENERATOR SETS—250 & 500 V. D.C.

1—100 KW 1200 rpm. 250 v. Westg. Gen. dir. con. to 220 v. 3 ph. 60 cy. Westg. Ind. Mtr.
1—80 KW 720 rpm. 250 v. G.E. Generator V-belt driven by 150 HP 1800 rpm. 220 or 440 v. 3/60 Westg. Motor.
1—85 KW 680 rpm. 250 v. Westg. Generator dir. con. to 220/440 v. 3/60 motor.
1—75 KW 250 v. West. Gen. dir. con. 440 v. 3 ph. 60 cy. AC Motors.
1—50 KW 250 v. DC Gen. dir. con. 220/440 v. 3 ph. 60 cy. AC Motor.

### INDUSTRIAL TRUCKS

9—Automatic type LO-5 Low Lift Trucks capacity 5 ton, platform type. Equipped with towing coupler and bumper for pushing cars.
10—New 4 ton Yale & Towne model YSW Multi-Stroke Hand Lift Platform Trucks.

***WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST, LIST YOUR IDLE EQUIPMENT WITH US***

## Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

# CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

### MOTOR—GENERATOR SETS

| KW | Make | DC Volts | AC Volts |
|---|---|---|---|
| 800 | Wtg. | 275 Syn. | 3/60/13200 |
| 500 | G.E. | 600 Syn. | 3/60/2300/4000 |
| 400 | Wtg. | 275 Syn. | 3/60/440 |
| 400 | G.E. | 250 Syn. | 3/60/2300 |
| 400 | G.E. | 275 Syn. | 3/60/440 |
| 300 | G.E. | 250 Syn. | 3/60/480 |
| 300 | C. W. | 300 Syn. | 3/60/4000/2300 |
| 225 | Ideal | 115 Syn. | 3/60/2200 |
| 200 | Elliott | 115 Syn. | 3/60/480 |
| 200 | Wtg. | 250 Syn. | 3/60/440 |
| 100 | G.E. | 3 wire Syn. | 3/60/480 |
| 100 | G.E. | 250 Syn. | 3/60/2200 |
| 60 | Al. Ch. | 110 Ind. | 3/60/2300 |
| 50 | G.E. | 115 Ind. | 3/60/440 |
| 35 | G.E. | 250 Ind. | 3/60/220 |
| 17½ | G.E. | 125 Ind. | 3/60/2200 |
| 7½ | Cr. Wh. | 125 balancer set | |
| 7½ | G.E. | 60 Ind. | 3/60/440 |
| 3 | Hertner | 65 Ind. | 3/60/220 |
| 3 | Hertner | 45 Ind. | 3/60/220 |
| 3 | Lincoln | 110 Ind. | 3/60/220 |
| 2.5 | Nwatn. | 110 Ind. | 1/60/220 |

### SLIPRING MOTORS

3 phase, 60 cycle

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 800 | Wtg. | CW | 6600 | 507 |
| 600 | G.E. | IM | 2200 | 1200 |
| 600 | Al. Ch. | ANY | 2200 | 1180 |
| 600 | Wtg. | CW | 2300 | 343 |
| 350 | Wtg. | CW | 2300 | 720 |
| 300 | G.E. | IM | 2200 | 514 |
| 150 | G.E. | M547 | 2200 | 1200 |
| 100 | Wtg. vert. | CW | 2200 | 1160 |
| 100 | Ideal | AV | 2200/440 | 720 |
| 100 | Westg. | HF | 440 | 230 |
| 75 | Nwstn. | HW | 220 | 1740 |
| 75 | G.E. | IM | 440 | 860 |
| 50 | Wtg. | HF | 440 | 860 |
| 50 | Al. Ch. | ARY | 220 | 690 |
| 50 | G.E. | MT | 2200 | 600 |
| 40 | Cr. Wh. | 20Q | 220 | 1160 |
| 40 | Al. Ch. | ARY | 220 | 1160 |
| 30 | Wtg. | CW | 220 | 865 |
| 25 | G.E. | 1-M | 220 | 855 |
| 25 | G.E. | IM | 220 | 1140 |
| 25 | G.E. | IM | 220 | 855 |
| 15 | Wtg. | CW | 440 | 1740 |

**FREQUENCY CHANGER**

**1—1400 HP. General Electric type ATI-24-1250M-900, form C. 3 ph. 60 cy. 460 volt, 300 RPM. 1570 amps. 1250 KVA. 0.9 P.F. 50° synchronous motor with amort. wdg.: dir/conn. to 1000 KW General Electric type ATI-10-1250M-300. 3 ph. 25 cy. 460 volts. 300 RPM. 1570 amps. 1250 KVA. 0.8 P.F. 50° A.C. generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)**

### SQUIRREL CAGE MOTORS

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 350 | G.E | KT563 | 440 | 1765 |
| 150 | Wtg. | CS | 2200 | 720 |
| 200 | Wtg. | CS | 440 | 580 |
| 150 | Al. Ch. | | 440 | 570 |
| 150 | G.E. | 1-K | 440 | 1730 |
| 150 | Wtg. | CS | 2200 | 1710 |
| 150 | G.E. | I-K | 2250 | 580 |
| 100 | Wtg. | CS | 2200 | 870 |
| 100 | G.E. | KF | 440 | 900 |
| 75 | G.E. | KT | 2200 | 1800 |
| 75 | Al. Ch. | ARY | 2200 | 1800 |
| 60 | Wtg. | CS vert. | 2200 | 1750 |
| 60 | G.E. | KT333 | 220 | 1740 |
| 60 | G.E. | K504 | NEW | 1200 |
| 60 | G.E. | KT | 440 | 865 |
| 50 | G.E. | KT | 440 | 1160 |
| 50 | Wtg. | CS | 440 | 699 |
| 50 | Al. Ch. | | 440 | 570 |
| 50 | Cr. Wh. | | 220 | 1200 |
| 40 | G.E. | KF44Y | 2200 | 1745 |
| | | gear type to 581 RPM | | |
| 40 | G.E. | K440 | NEW | 1200 |
| 40 | Al. Ch. | | 440 | 850 |
| 40 | Wtg. | CS | 440 | 1800 |
| 35 | Wtg. | CS | 2200 | 1170 |
| 35 | G.E. | I-K | 440 | 680 |
| 35 | Al. Ch. | | 440 | 480 |
| 30 | G.E. | KT | 220 | 600 |
| 35 | G.E. | KT | 220 | 900 |
| 35 | G.E. | IK | 440 | 1200 |
| 25 | G.E. | KT | 440 | 600 |
| 25 | G.E. | K-364 | NEW | 1800 |

### SQUIRREL CAGE MOTORS

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 25 | Howell | SC | 220 | 600 |
| 25 | G.E. | KT | 220 | 1125 |
| 20 | Cr. Wh. | 1170 | 440 | 1140 |
| 20 | Wagner | 195BP | 220 | 1200 |
| 20 | G.E. | TEFC | NEW | 1800 |
| 20 | G.E. | K864 | NEW | 1800 |
| 20 | G.E. | KT326 | 220 | 870 |
| 20 | G.E. | KF | TEFC | 1800 |
| 20 | Al. Ch. | AN | 220 | 850 |
| 20 | Westg. | CCL | 220 | 850 |
| 20 | Reliance | 60AA | 440 | 1750 |
| 20 | G.E. | KT-512-6 | 220 | 1200 |
| 20 | G.E. | KT-312-6 | 220 | 1145 |
| 20 | G.E. | KR365 | 220/440 | 1700 |
| 20 | Wagner | 15VRN | 440 | 1200 |
| 15 | I. Allis | OX326X | 440 | 1760 |
| 15 | Wagner | 15VRP | 220 | 860 |
| 15 | Wagner | 15RPI | 440 | 1160 |
| 10 | Lincoln | I-K | 440 | 1200 |
| 7½ | F. M. vert. | UHI | 220/440 | 3470 |
| 15 | Cr. Wh. | | 440 | 1140 |
| 3 | Willey | intm.d. | 440 | 1050 |
| 3 | Howell | SC | 440 | 600 |
| 7½ | G.E. | KT-180 | 220 | 1800 |
| 7½ | Cr. Wh. | | 440 | 1160 |
| 5 | Howell | SC | 220 | 3600 |
| 5 | Sterling | KFW | 440 | 1800/900 |
| 7½ | Wtg. | CS | 220 | 1740 |
| 3 | Al. Ch. | AR108-D | 220 | 1750 |
| 3 | West. | CS234 | 220 | 1140 |
| 3 | Willey | intm.d. | 440 | 1050 |
| 3 | Cr. Wh. | TEFC | 220/440 | 1720 |

### SYNCHRONOUS MOTORS

3 phase, 60 cycle

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 2100 | G.E. | ATI | 4600 | 514 |
| 750 | G.E. | Conds | 550 | 900 |
| 500 | G.E. | TS | 2300 | 450 |
| 270 | G.E. | ATI | 440 | 600 |
| 150 | Burke | SI1375 | 2200 | 600 |
| 100 | Cr Wh. | .8PT | 240 | 900 |
| 35 | G.E. | ATI | 220 | 1200 |
| 15 | Century | | 550 | 1200 |
| 10 | G.E. | ATI | 240 | 900 |
| 5 | G E | K324 | 220 | 1800 |

### TRANSFORMERS

Single phase, 60 cycles

| Qu. | kva | Make | Type | Voltage |
|---|---|---|---|---|
| 3 | 1000 | | SC | 13200/480 |
| 3 | 833 | | SC | 6600/2300 |
| 2 | 100 | G.E. | H | 1200/220/440 |

### TRANSFORMERS

| Qu. | Kva | Make | Type | Voltage |
|---|---|---|---|---|
| 1 | 100 | Wtg. | SK | 2300/110/220 |
| 3 | 75 | Wtg. | S | 3810/244/122 |
| 2 | 75 | Wtg. | S | 2200/110/220 |
| 1 | 75 | G.E. | H | 2300/230/460 |
| 8 | 50 | G.E. | H | 2200/220/440 |
| 1 | 50 | Fitts | | 13200/6600 |
| 3 | 50 | Moloney | HE | 2300/230/460 |
| 3 | 50 | Pitts. | | 2200/110/220 |
| 1 | 50 | G.E. | H | 12000/110/220/440 |
| 1 | 40 | Packard | A | 2200/110/220 |
| 1 | 40 | G.E. | H | 2300/230/460 |
| 1 | 40 | Pitts. | | 2200/110/220 |
| 1 | 37½ | G.E. | H | 2300/230/460 |
| 2 | 37½ | G.E. | H | 12000/230/440 |
| 1 | 37½ | G.E. | H | 26400/2300 |
| 1 | 30 | G.E. | H | 2300/110/220 |
| 1 | 30 | Moloney | HE | 13200/230 |
| 1 | 25 | G.E. | H | 2300/2300 |
| 1 | 20 | Kuhlman | | 2300/115/230 |
| 1 | 20 | Moloney | | 1100/2200/110/220 |
| 4 | 20 | G.E. | | 1100/2200/110/220 |
| 1 | 20 | G.E. | H | 2200/220/440 |
| 1 | 15 | G.E. | H | 6900/2300 |
| 1 | 15 | G.E. | H | 2400/120/240 |
| 1 | 15 | G.E. | A | 1050/2200/288 |
| 1 | 15 | Pitts. | 25 cy. | 2200/110/230 |
| 3 | 15 | G.E. | H | 13000/2300 |
| 1 | 15 | G.E. | H | 11000/2200 |
| 1 | 15 | G.E. | H | 440/110/220 |
| 3 | 15 | Albertson | | 2300/115/230 |
| 1 | 15 | Westg. | S | 2300/115/230 |
| 2 | 10 | G.E. | A | 2200/110/220 |
| 1 | 10 | Moloney | HE | 2300/110/220 |
| 1 | 10 | Stanley | BO | 2200/110/220 |
| 1 | 10 | W.E. | T | 2200/110/220 |
| 1 | 10 | Packard | | 2200/110/220 |

### STEAM ENGINES

400 KVA Filer-Stowell 15x28x36 cross compound Corliss engine, with Crocker Wheeler 3 phase 60 cycle, 220 or 440 volts AC generator.
676 KVA G.E. A.C. generator, 3 phase, 60 cycle, 480 volt, direct-connected to Ames uniflow horizontal steam engine.

**This is a partial listing, only have NEW from ¼ to 75 hp right in stock.**

**WE ARE ALWAYS IN THE MARKET FOR ALL TYPES OF GOOD MODERN ELECTRIC MOTORS, MOTOR-GENERATOR SETS GENERATORS, TRANSFORMERS, AND OTHER ELECTRICAL EQUIPMENT. SEND US YOUR LISTS FOR BEST CASH OFFERS.**

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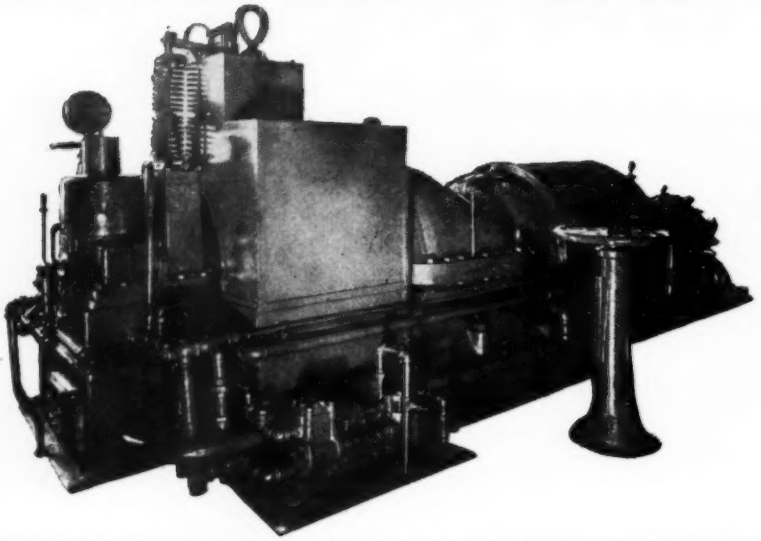
# DEPENDABLE
# TURBINE-GENERATORS

IF UNIT Desired is Not Listed Send Us Your Specifications.



**SPECIALS**

7500-KVA, G.E.

1500 KW, G.E.

*Write for Specifications Prices*

**WESTINGHOUSE 1000-KW, Aut. Extraction-Condensing Turbine-Generator**

7500—KVA. G.E. Sur. Cond. 190 375#: 2300-v.
6250—KVA. G.E. Sur. Cond. 200 2300#-v.
5000—KVA. G.E. Sur. Cond. 200 400#: 2300 v.
3750—KVA. G.E. Sur. Cond. 200# 2300-v.
3125—KVA. G.E. Sur. Cond. 200# 2300-v.
2500—KVA. G.E. Sur. Cond. 200# 2300-v.
1565—KVA. G.E. Sur. Cond. 150# 2300
1250—KVA. Westinghouse, 200# 2300-v.
1250—KVA. West. Sur. Cond. 200# 2300
1250—KVA. Allis-C. Cond. 150# 480-v.
937—KVA. Allis-C. Cond. 200#.
937—KVA. G.E. 200# Cond. 2300-v.
625—KVA. G.E. 200# 2300-v.

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*STEAM TURBINE-GENERATOR ENGINEERS - TELEPHONE CADILLAC 1340-1*



# LIQUIDATION SALE! MODERN SHIPYARD

***MILLIONS OF DOLLARS WORTH OF SURPLUS MACHINERY AND EQUIPMENT***

**(FORMERLY GOVERNMENT OWNED)**

**99% PURCHASED NEW SINCE 1942!**

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**on the premises BAY AND LAFAYETTE STS., JACKSONVILLE, FLA.**

***Partially Comprising***

**AIR COMPRESSORS**

3—3400 C.F.M. Ingersoll Rand Air Compressors, 700 HP Syn. motors, 3/60/2200 v. complete with air receivers, exciters, switch gear, etc.
2—315 C.F.M. Ingersoll Rand Portable Compressors, type GK315.
2—160 C.F.M. Ingersoll Rand Portable Compressors Type DK-160.

**CRANES**

**Material Handling (Whirleys)**

6—35 Ton American Hoist & Derrick Model R 20, 90' boom.
2—45 Ton American Hoist & Derrick Model R-20, 90' Boom.
1—50 Ton American Hoist & Derrick Model R 25, 110' boom.
(All Fully Electric with 3/60/440 volt Motors)

**OVERHEAD (BRIDGE TYPE)**

6—10 Ton Whitings, 70' span.
6—10 Ton Harnischfeger, 70' span.
1—7½ Ton Erie, 70' span.
1—10 Ton Harnischfeger, 80' span
1—25 Ton Harnischfeger, 80' span, aux. hook.
(All Three Motor Type with 3/60/440 volt Motors)

**LOCOMOTIVE**

2—25 Ton American Diesel & Gasoline Driven Locomotives, 60' boom.
1—50 Ton Brownhoist Type L, Steam Driven Locomotive, 100' boom.
1—25 Ton Ohio Steam Driven Locomotive, 60' boom.

**CRAWLER**

2—65 Ton Lima Type 1201, Diesels, 60' boom, 40' insert.

**MOBILE**

1—30 Ton Osgood Model 805, Diesel 60' boom, 18 wheel.
1—15 Ton General Gasoline, 40' boom, 12 wheel.
2—15 Ton Linkbelt Model T70, Gasoline, 40' boom, 8 wheel.

**GANTRY**

2—10 Ton Whiting Diesel Electric, 100' span, 3 motor, 230 volt D.C.
1—10 Ton Alliance Diesel Electric, 100' span, 3 motor, 230 volt D.C.
1—15 Ton McMyler Full Electric, 100' span, 3/60/440 v.

**MISCELLANEOUS CRANES**

4—15 Ton Hyster Straddle Trucks "Yardmaster," model MH57-108, 100 HP Gasoline Engine.

**ROLLING STOCK**

**LOCOMOTIVES**

2—45-Ton Whitcomb Diesel Elec., 20,000 Drawbar Pull—wheel arrangement 0-8-0.
1—Baldwin Locomotive & Tender, Steam, 28,700 Traction, wheel arr. 0-8-0.
1—DIESEL TRACTOR LOCOMOTIVE, 10,000 drawbar pull,—8 wheels 4 wheel drive.

**CARS**

20—Flat Cars, 40', 30 Ton.
1—Boxcar, 40', 36 Ton.

**TRAILERS**

5—15, 30, 50 Machinery Type Utility Trailers.

**MISCELLANEOUS**

300 Transformers from 5 to 750 KVA.
1200 Welders from 200 to 600 Amps.
3000 Pneumatic Tools.
Shipyard Portable Boring Bars.
200 Portable Electric Drills.
800 Pressure Propeller Exhaust Fume Blowers and Fans.
350 Chain Hoists from ½ to 16 Tons.
1000 Hyd. Ratchet and screw jacks 1 to 20 ton.
650 Fire Extinguishers.
400 Oil and gas fired forges and heaters.
350 Bench, pipe hyd. vises.
1000 Bending Slabs, 60" x 60" and 40" x 40".
300 Hand Trucks, rubber wheels.
150 Spring dial pressure gauges.
Immense quantity of electrical equipment, including volt and ammeters, measuring sets, indicators . . . thousands of drills, reamers, taps, micrometers, calipers, dial indicators, hammers, wrenches, tinsmith snips, and thousands of items too numerous to mention.

**ALSO . . . . .**

MACHINE TOOLS: LATHES (Engine, Turret, Vertical) VERTICAL BORING MILLS, RADIAL DRILLS, MILLERS, GRINDERS, BENDING ROLLS, HYDRAULIC PRESSES, HYDRAULIC PIPE BENDERS, VERTICAL PUNCHES, HORIZONTAL PUNCHES, PLATE AND ANGLE SHEARS, BURNING EQUIPMENT, Etc., Etc.

*All Motors unless otherwise noted are 3/60/220-440 Volts.*

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# INDUSTRIAL PLANTS CORPORATION

***Professional Auctioneers — Appraisers — Liquidators***

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## IN STOCK
# DIESELS

1—1500 HP Electric Boat Company Nelseco Supercharger with direct connected AC Generator
1—750 HP Superior with or without AC Generator
2—375 HP McIntosh-Seymour with AC Generators
2—360 HP Fairbanks-Morse with AC Generators
1—120 HP Fairbanks-Morse with AC Generator
10—75 HP New International Harvester UD-18 with AC Generators
12—65 HP New International Harvester UD-14 with AC Generators
2—45 HP New International Harvester UD-9 diesel power units with clutch and power takeoff
1—35 HP New International Harvester UD-6 diesel power unit
1—30 HP Lister with AC Generator
1—16 HP Lister
1—15 HP General Motors Power unit

***MANY OTHER UNITS AVAILABLE***

**A. G. Schoonmaker Company**
*Business Established 1898*
**50 Church St. New York 7, N. Y.**
*Phone Worth 2-0455*

# A. C. TURBINES

## FOR SALE

2—300 KW GENERAL ELECTRIC ALTERNATORS, type ATB, form T, .80 P.F., 375 KVA 3/60/2300 volt, 3600 RPM, 94 Amps. Direct connected to: CURTIS TURBINES non-condensing, 175 lbs., type L-25"—2 stage, form C, serial #19177-19178.

## STEAM GENERATOR SETS

1—50 KW Engberg Vertical 125 V., 416 Amps., 300 RPM, 100 lbs. pressure, flywheel governor.
3—35 KW Sturtevant Vertical 125 V., DC. type VS7, 10 x 9, 100 lbs. pressure flywheel governor.
2—35 KW Westinghouse Turbines 125 volt DC, 100 lbs. pressure.

**ALJON ELECTRIC DIESEL CO.**
151-55 Washington St., Brooklyn 1, N. Y.
MAIN 4-3804

## FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

## APPLICATION ENGINEERS

50 KW—M. G. Syn. Set—440 AC to 250 DC.
500 KW—Westinghouse 240 V. Non-cond. turbine.
96 KW—240 Volt AC uniflow engine set.
375 KVA—480 Volt Ball 4-Valve engine set.
187 KVA—240 Volt Chuse 4-Valve engine set.
120 HP Fairbanks Morse Diesel engine.
List surplus equipment with us.
**HOWARD B. JOHNSON & ASSOCIATES**
53 W. Jackson Blvd. Chicago 4, Ill.

## FOR SALE
# BOILERS

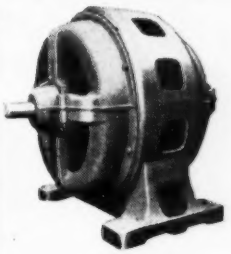
Two 4-drum boilers, 1,001 h.p. each. 250 pounds w.p. Drums. Structural steel and trim. All good condition. We'll furnish new tubes. Available at once.

One 4-drum boiler. 500 h.p. 200 pounds w.p. Ten years old with stoker. All in fine condition. Available at once.

**Michigan Boiler & Engineering Co.**
4120 W. Jefferson, Detroit 9, Mich.
*Phone Lafayette 5680*

# 25 CYCLE WORLD'S LARGEST STOCK
# MOTORS GENERATORS TRANSFORMERS

**STOCK SHIPMENT FROM ROCHESTER AND BUFFALO**



**All equipment rebuilt in our own shops and guaranteed on same basis as new equipment.**

### SQUIRREL CAGE

#### 220-440 VOLT

| | | |
|---|---|---|
| 150 | G.E. | 500 |
| 150 | G.E. | 750 |
| 150 | West. | 1500 |
| 150 | F.M. | 1500 |
| 125 | G.E. | 1500 |
| 100 | G.E. | 500 |
| 100 | G.E. | 1500 |
| 75 | West. | 500 |
| 75 | West. | 750 |
| 75 | G.E. | 1500 |
| 60 | G.E. | 1500 |
| 60 | West. | 750 |
| 50 | G.E. | 500 |
| 50 | G.E. | 750 |
| 50 | A.C. | 750 |
| 40 | G.E. (TE) | 750 |
| 40 | West. | 750 |
| 40 | A.C. | 1500 |
| 30 | West. | 750 |
| 30 | G.E. | 750 |
| 25 | West. | 1500 |
| 25 | G.E. | 750 |

862 additional motors down to 1 H.P.

#### 2200 VOLT

| | | |
|---|---|---|
| 200 | West. | 500 |
| 200 | G.E. | 500 |
| 200 | West. | 1500 |
| 200 | West. | 750 |
| 150 | West. | 750 |
| 150 | West. | 1500 |
| 100 | G.E. | 750 |
| 75 | West. | 750 |
| 50 | G.E. | 750 |
| 30 | G.E. | 750 |

### SLIP RING

| | | |
|---|---|---|
| 650 | West. | 365 |
| 300 | G.E. | 365 |
| 250 | G.E. | 500 |
| 200 | West. | 500 |
| 200 | G.E. | 500 |
| 150 | G.E. | 500 |
| 150 | G.E. | 750 |
| 125 | West. | 500 |
| 125 | A.C. | 750 |
| 125 | G.E. | 1500 |
| 100 | West. | 750 |
| 75 | G.E. | 750 |
| 75 | West. | 750 |
| 60 | West. | 750 |
| 50 | G.E. | 750 |
| 50 | G.E. | 1500 |
| 40 | G.E. | 750 |

### MOTOR GENERATORS

| | | |
|---|---|---|
| 5 | KW | 80 Volt |
| 7½ | KW | 250 Volt |
| 15 | KW | 250 Volt |
| 30 | KW | 6 Volt (Plater) |
| 35 | KW | 125 Volt |
| 50 | KW | 125 Volt |
| 50 | KW | 250 Volt |
| 100 | KW | 125 Volt |
| 100 | KW | 250 Volt |
| 150 | KW | 125 Volt |
| 150 | KW | 250 Volt |
| 200 | KW | 125 Volt |

**We can assemble sets to your "specs." Wire details collect.**

### FREQUENCY CHANGERS

| OUTPUT | | |
|---|---|---|
| 4 | KW | 60-1 |
| 3 | KW | 120-3 |
| 75 | KW | 60-3 |
| 120 | KW | 130-3 |
| 200 | KW | 60-3 |
| 500 | KW | 60-3 |

### ALTERNATORS AND SYNCHRONOUS MOTORS

| | | |
|---|---|---|
| 500 | G.E. | 750 |
| 300 | G.E. | 750 |
| 300 | E.M. | 214 |
| 225 | E.M. | 500 |
| 200 | West. | 750 |
| 75 | E.M. | 500 |
| 75 | G.E. | 750 |
| 20 | Ideal | 1500 |
| 5 | G.E. | 1500 |

### TRANSFORMERS

| | | |
|---|---|---|
| 250 | West. | 2300—460/230 |
| (3)—200 | Pitts. | 13800—460/230 |
| (2)—200 | Packard | 440—110 |
| (3)—150 | Maloney | 6600—460/230 |
| (2)—150 | G.E. | 13200–11500—2300 |
| 150 | West. | 6600–2300—460/230 |
| 100 (3 ph.) | G.E. | 220—110 |
| (3)— 50 | G.E. | 6600—460/230 |
| (3)— 50 | Kuhlman | 2300—115/230 |
| (3)— 30 | G.E. | 4400—230/460 |
| (3)— 25 | G.E. | 2300—115/230 |
| (3)— 25 | G.E. | 11000—220/440 |
| (3)— 10 | G.E. | 2200—110/220 |
| (3)— 5 | G.E. | 2200—110/220 |

**Our stock of 60 cycle and D.C. is equally varied and large. Wire inquiries collect.**

# ELECTRIC EQUIPMENT CO.
**TELEPHONES: GLENWOOD 6783-6784-6785**
63 CURLEW STREET, P. O. BOX 51 ROCHESTER 1, N. Y.

## SLIP RING MOTORS
3-PH., 60 CY.

| HP | Volts | Make | Speed |
|---|---|---|---|
| 900 | 2300 | G.E. | 900 |
| 500 | 2300 | G.E. | 900 |
| 400 | 2300/440 | Whse. | 400 |
| 400 | 2300/440 | G.E. | 600 |
| 350 | 2300/440 | G.E. | 600 |
| 300 | 440 | Al. Chal. | 900 |
| 300 | 2200/440 | G.E. | 600 |
| 300 | 2200 | G.E. | 1800 |
| 250 | 2300 | G.E. | 600 |
| 250 | 440/550 | G.E. | 600 |
| 200 | 2200/440 | G.E. | 600 |
| 150 | 2200 | G.E. | 450 |
| 150 | 2200/440 | G.E. | 600 |
| 125 | 440/220 | G.E. | 1200 |
| 125 | 440/220 | G.E. (Hoist) | 900 |
| 100 | 220/440 | G.E. | 720 |
| 100 | 440/220 | G.E. MTC | 900 |
| 100 | 550 | G.E. | 900 |
| 100 | 2300 | G.E. | 900 |
| 100 | 2200 | G.E. | 1800 |
| 75 | 2200 | Al. Chal. (new) | 900 |
| 75 | 440/220 | G.E. (MTC) | 600 |
| 75 | 2200/440 | G.E. | 1200 |
| 50 | 2200/440 | G.E. | 600 |
| 75 | 550 | G.E. | 900 |
| 60 | 2200 | G.E. | 900 |
| 40 | 2200 | Whse. | 900 |
| 40 | 2200 | G.E. | 1200 |

## SYNCHRONOUS MOTORS
3-PH., 60 CY.

| | | | |
|---|---|---|---|
| 300 | 440/220 | Al. Ch. | 600 |
| 200 | 2200 | Whse. | 900 |
| 110 | 440 | Whse. | 900 |
| 100 | 2200/550 | Al. Ch. | 1800 |
| 100 | 440/220 | G.E. | 360 |
| 75 | 440/220 | G.E. | 720 |

## OUTDOOR OIL CIRCUIT BREAKERS

1—New 400 Amp. Type FK, 134-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.
3—NEW 400 amp., Type FKO 227, G. E., 7500 V., outdoor type, hand-operated.
1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt.

## TRANSFORMERS
60 CYCLE

4—1250 kva, Al. Chal., 13800-460/230 V.
3— 833 kva. Whse., 11000-2300 V.
3— 500 kva, G.E., type H, form KS, 13800-230/460.
3— 333 kva., G.E., 66000-480 V.
1— 300 kva., Whse., 3 Ph., 13800-230 V.
3— 250 kva., Whse., 13,800-460.
3— 200 kva., Whse., 11000Y-2300 V.
3— 200 kva., G.E., 13200-480 V.
6— 200 kva., G.E., NEW PYRANOL, 2300-460 V.
3— 150 kva., G.E., type HTQ, 4150-240/480 V.
3— 150 kva., G.E., H-KDD 13200-2300.
3— 150 kva., G.E., H-KS, 2400-240/120 V.
3— 100 kva., G.E., type H 2400-240-480.
3— 100 kva., G.E., type H-KDD, 6900/11950V-230/115.
3— 100 kva., G.E., type H-KB 6600/11430Y-2300 V.
3— 100 kva., G.E., H-KDD, 6600/11950-230/115 V.
3— 100 kva., G.E., H-KS, 2400-240/480 V.

## TURBO-GENERATOR SET

1—11250 kva., 1200 rpm., 220/440 v., 3 ph., 60 cy., G.E., conn. to Terry, 3600 rpm., non-cond. turbine, 100/150 lbs. gu.

## SQUIRREL CAGE MOTORS

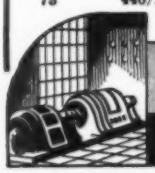
| HP | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 500 | 440/220 | G | IK | 1200 |
| 500 | 440/220 | G.E. | IK | 900 |
| 400 | 2200/440 | Whse. | CS | 720 |
| 300 | 440 | Whse. | CS | 450 |
| 250 | 2200/440 | G.E. | IK | 600 |
| 250 | 2200 | G.E. | IK | 450 |
| 200 | 440/220 | G.E. | IK | 1200 |
| 150 | 440/220 | G.E. | KT | 720 |
| 150(3) | 440/220 | G.E. | KT | 1200 |
| 125 | 440 | G.E. | K | 514 |
| 125 | 440/220 | G.E. | KT | 1800 |
| 125 | 440/220 | G.E. | KT (Vert.) | 1800 |
| 100 | 440 | G.E. | IK | 450 |
| 100 | 2200 | G.E. | KT | 1800 |
| 100 | 440 | Whse. | CS | 1200 |
| 100 | 550 | Cr. Wh. | | 720 |
| 100 | 550 | G.E. | KT | 900 |
| 74 | 2200 | G.E. | KT | 900 |
| 50 | 2200 | Al. Chal. | | 720 |

## MOTOR GENERATOR SETS

1—75 KW, 250 V, 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V, 850 RPM, Whse. conn. to 75 HP. 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.
1—50 KW, 125 V., 1200 RPM, Whse. conn. to 75 H.P. 2200/220 V.; 3 ph., 60 cy., Sq. Cage Motor
1—35 KW, 125 V., 1800 RPM., G.E., conn. to 50 HP., 440/220 V., 60 cy., squirrel cage.

## A.C. GENERATORS

1—375 kva, 514 rpm, 480/240 V. G.E.
1—250 kva, 600 rpm, 440/220 V. Al. Ch.
1—200 KVA, 600 RPM, 4150/2300 V., Cr. Wh.
1— 96 kva, 360 rpm. 480/240 V. G.E.



## STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

## 2—4000 KVA. 60 Cy. 3 PH. TURBO WITH SURFACE COND.

1—3125 Kva. G.E. Turbo 230 V. 60 Cy. 3 ph.
100 KW. 550 V. 3600 Rev. 60 CY. 3 PH. turbo with exciter.
1500 CFM 2 STAGE AIR COMP. 275 HP. 60 CY. 2200 V. Syn. Motor Dr.
2—Cent. Pumps 4166 GPM, 162' Head, 1750 Rev.
1—36000 GPM. 27' or 25000 GPM 40' Hd. 285 Rev. Cent. Pump.
2—50 KW. 480 V. 60 CY. 3 PH. OIL ENGINE SETS.
1—187 KVA. 480 V. 60 CY. 3 PH. 225 Rev. Engine Set.
1—312 KVA. 480 V. 60 CY. 3 PH. 200 Rev. 4 Valve Rebuilt Eng. Set.
1500 and 2500 HP. 60 CY. A.C. Motors, 435 and 257 Rev.

**ROSS POWER EQUIPMENT CO. Indianapolis 4, Ind.**

## PUMPS

*Rebuilt & Guaranteed*

PUMPS—Large stock centrifugal—turbine—piston

STEAM PUMPS—Duplex - Simplex Reconditioned and guaranteed

BOILERS—stacks—Engine Generators—condensers.

**LOU COHEN & CO.**

1030 N. 6th St. St. Louis 1, Mo.

## -TRANSFORMERS-

**TRANSFORMERS WANTED**

in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
Write for Catalog No. 135-F

**THE ELECTRIC SERVICE CO., INC.**

"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI, OHIO

## DIESEL GENERATOR UNIT

1500 H.P.—1250 KVA
Nelseco — General Electric
Modern, Supercharged, Bosch Injection
3/60/2400, 300 RPM, All Accessories, Complete
Immediate Stock Delivery Rebuilt

**A. G. SCHOONMAKER COMPANY**
50 Church St., New York 7, N. Y.
Phone Worth 2-0455

## POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

### A.C. TURBINE UNITS

5000 KVA GE 2300/4000 v. (bleeder)
3750 KVA GE 2300 v. Cond.
1560 KVA Wghse 480 v. (bleeder)
1556 KVA Al. Chal. 2300 v. Cond.
1556 KVA Al.Chal. 480 V. non-cond.
1250 KVA Al.Chal. 480 V. non-cond.
1250 KVA G.E. 2300 v. (bleeder)
750 KVA G.E. 2300 v. Cond.
625 KVA Wghse. 480 v. (bleeder)
625 KVA G.E. 2300 v. Cond.
625 KVA Elliott 480 V. non-cond.
312 KVA Elliott 480 V. cond.
110 KVA Al.Chal.-Kerr non-cond.

### MOTOR GENERATOR SET

150 KW G.E. 250 volt—225 HP G.E. 3-60-440 V. synchronous motor.

### UNIFLOW UNITS

1000 KVA G.E.—Skinner Uniflow
625 KVA G.E.—Skinner Uniflow
350 KVA G.E.-Ames
187 KVA (2) G.E.—Chuse 4 valve
168 KVA Al. Chal.-Ames

### W. T. BOILERS

1047 HP. (2) Heine 250#
758 HP. (2) Sterling 250#
500 HP. Heine; 200# (oil)
400 HP (2) Heine 190#
365 HP. Kidwell, 200#
310 HP (2) Union, 175#, cr. dr.
300 HP (2) Heine Marine type 250#

### DIESEL ENGINE UNITS

375 KVA G.E. (2)-Worthington
225 KVA W.E.-Worthington
125 KVA W.E.-Worthington

## FOR SALE

New and guaranteed used steel pipe in large quantities up to 36" inclusive, also, new and guaranteed used boiler tubing, steel buildings, steel and wood tanks, valves, fittings and pumps.

**Jos. Greenspon's Son Pipe Corp.**
NATIONAL STOCK YARDS
St. Clair County, Illinois

# BOILERS

***NEW and USED***

*All makes & sizes for prompt shipment several attractive assorted sizes.*

SPECIAL OFFER
400-HP . . . 175 lbs. Stirling Boilers
3—250 HP Heine Water Tube Type

**J. F. DAVIS CO.**
122 S. Michigan Ave. CHICAGO
Telephone Harrison 0755

## STEAM PUMPING ENGINES

1—Snow 8MGD C&FW cr. Com. Opp. Type Cond. 26x54x17x36, with waterworks type condenser.
1—Snow 6 mgd. C&FW Cr. Com. Opp. Type Cond. 20x40x14½x36 with waterworks type con.
1—Allis-Chal. 4 mgd. cr. com. cond. Size 12x28x18x24. All fine cond.
1—Worth Cr. Comp. Cr. & Fly wheel LDG Meyer Valve gear, 1 MGD. size 10/20x7½x18.

## PUMP VALVES

Birch Valves for all tyes of reciprocating pumps.

## STEAM GENERATOR SET

West. AC 125 KVA, 2300 V 3/60 225 RPM Exciter West. DC Gen. Hamilton Eng. Uniflow Switchbd. Stm. Press 140#.

**BIRCH MANUFACTURING COMPANY**
1523 Sedgwick St. Chicago 10, Ill.

## BOILERS

2 ERIE CITY longitudinal, box header water tube boilers with Type-E, stokers, 400 H.P. (each) headers are equipped with KEY CAPS—OHIO, PENN'A. & ASME Stamping.

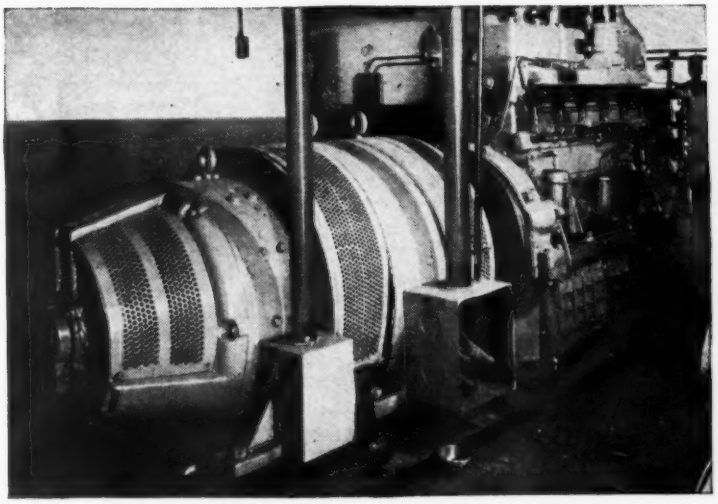
**H. P. BREARLEY**
3423-91St. Street Jackson Heights, N. Y.

## NEW INSULATED MAGNET WIRE

| Size | Description | Approx. Weight |
|---|---|---|
| .072" (#13 AWG) | Triple Cotton Cov. Round | 235½ # |
| .072" (#13 AWG) | Asbestos Ins. Reels | 133 # |
| .049" x 437" | Double Cotton Cov. Rect. | 662 # |
| .051" x .114" | Double Glass Cov. Rect. | 1215 # |
| .051" x .325" | Double Cotton Cov. Rect. | 623 # |
| .064" x .325" | Asbestos Ins. Rect. | 130 # |
| .064" x .365" | Asbestos Ins. Rect. | 978 # |
| .035" x .155" | Double Vitreous | 1681 # |
| .070" x .250" | Double Vitreous | 2086 # |
| .110" x .185" | Double Vitreous | 217 # |
| .032" x .365" | Double Glass Cov. | 7378 # |
| .040" x .365" | DoubleGlass Cov. | 4078 # |
| .063" x .625" | Double Cotton Cov. | 268 # |
| .085" x .195" | Double Cotton Cov. | 276 # |
| .146" x .280" | Double Glass Cov. | 261 # |
| .0403" (#18 AWG) | Asbestos Ins. | 207 # |
| #21 AWG | Single Vitreous | 2603 # |
| #17 AWG | Dbl. Cot. Cov. Enamel | 7111 # |
| #29 AWG (.1113) | Single Glass Cov. | 206 # |
| .0201" (#24 AWG) | Enameled Syn. | 1395½ # |
| .036" (#19 AWG) | Single Cot. Cov. Enamel | 766 # |
| .057" (#15 AWG) | Enameled with one wrap of Manila Rope Paper | 12616 # |

**DULIEN STEEL PRODUCTS, INC.**
2280 WOOLWORTH BLDG. N. Y. 7, N. Y.
*Tel. Cort. 7-4676*

# A. C.-D. C. AUTOMATIC DIESEL GENERATOR PLANT



170 H.P. BUDAS—2LD9090
2—44 KVA.—3/60/120-208
2—25 KW.—240 VOLT D.C.

**STRONG SYSTEM AUTOMATIC SWITCHBOARDS**
**115 PHILCO GLASS-STEEL STORAGE BATTERIES**
**MOTOR GENERATOR SET**
**COST $34,500**
**Like New—Bargain $8750**

**ROBERT SCHOONMAKER**
Port Washington, Long Island, N. Y.
Phone Roslyn 1220

## TURBO GENERATORS

1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3600 RPM, direct-connected exciter, Wheeler Jet Condenser.
1—2000 KW General Electric Turbo-Generator, 180 lb. pressure, 3600 RPM Generator, Type ATB, 600 Volt AC, 2403 Amp. with Westinghouse-LeBlanc Jet Condenser.
1—1500 KW Westinghouse Turbo Generator with Surface Condenser 4200 sq. ft.

## BOILERS

3—400 HP Casey Hedges Water Tube Boilers.
1—500 HP Casey Hedges Water Tube Boiler. Foster Superheater. These boilers are oil fired, system complete, automatic draft control equipment, etc.

**Republic Textile Equipment Co.**
40 Worth Street, New York 13, N. Y.
Phone: COrtlandt 7-1591

## NEW CHRYSLER DIESEL POWER UNITS

75 H.P. Model IND10-16, 6 Cylinder Electric Start. Includes: 4 Batteries, Radiator, Hood, Tool Kit, etc.

Immediate shipment—
Limited supply

Substantial discount to dealers.

**ALJON ELECTRIC DIESEL CO.**
151-55 Washington Street, Brooklyn 1, N. Y.
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## *Rebuilt and Sold with a Standard New Guarantee*

**IND. FREQUENCY CHANGERS SETS**

**MOTOR GENERATOR SETS**
**ALTERNATORS ALL FREQUENCIES**
**TRANSFORMERS LARGE STOCK**
**D. C. GENERATORS ALL VOLTAGES**
**CONTROL EQUIPMENT**

**ALL SIZES, VOLTAGE AND CYCLES**

**3 ph. 60 cy. A. C. Motors**
**3 ph. 25 cy. Motors**
**125 Volt D. C. Motors**
**230 Volt D. C. Motors**
**550 Volt D. C. Motors**

***WRITE OR WIRE YOUR INQUIRIES***

**BERGER BROTHERS Electric Motors, Inc., 395 STATE ST., ROCHESTER 4, NEW YORK**

**PUT ALL IDLE EQUIPMENT TO WORK. SEND YOUR LIST FOR PROMPT ACTION.**

# HIGH PRESSURE BOILER

## *PRICE REDUCED FOR QUICK SALE*

250# PRESSURE Wickes 607 H P 300% RATING water tube boiler. GUARANTEED TO PRODUCE 50,000 POUNDS OF STEAM FOR 2 HOUR PERIODS. Riley super stoker 300% rating—Combustion Engineering Co. Elesco, superheaters, induced and force draft fans motor driven with controls—5 Vulcan soot blowers—All valves on boiler. All trim such as pressure guages, water columns etc. Steel structural supports—Copes feed water regulator and other items—Will sell this boiler with or without stoker or fans

**PURCHASED AS A SPARE IN 1930 USED ABOUT 3 YEARS, LAST INSPECTION REPORT (MARCH 1945) ALLOWS 250 LBS. PRESSURE, HAS NOT BEEN USED SINCE.**

Boiler and accessories have been taken out and are now stored in New York City

**PRICED for IMMEDIATE SALE UNDER $10,000 for COMPLETE UNIT**

Present Location

***All data and inspection reports, etc., furnished upon request***

## HOWE BROTHERS

**324-328 PEARL ST., Tel. WORTH 2-2708-2709-2710 NEW YORK, N. Y.**

**200 HP**

# BOILER & STOKER

**78"x20' Welded HRT 160# working pressure. National Board #337. Bayer soot blower, Riley Jones 54.6 ft. stoker operates @ 150% rating with 10500 BTU coal. Complete as installed including Elliott deareating heater, 2 boiler feed pumps, flue gas thermometer, steam recording flow meter, etc.**

**Only 10 yrs. old and excellent condition. $5000 fob St. Louis. Immediately available.**

**MISSISSIPPI VALLEY EQUIPMENT CO.**
507 Locust St., St. Louis 1, Mo.

**Power Equipment—Diesels—Cranes—Locomotives Steel Sheet Piling—Rented—Purchased.**

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CUT TO SKETCH ⅛"-24"
METROPOLITAN
PLUMBING SUPPLY CO., INC.
INDUSTRIAL AND MARINE SUPPLIES
LARGE SURPLUS STOCK
STEEL-WROUGHT IRON-CAST IRON
BRASS-COPPER-CEMENT LINED PIPE
Power Plant Valves & Engineering Specialties - Jenkins - Fairbanks & Sarco Valves
313 East 31st Street, N.Y.C.
HOURLY NATION WIDE SHIPMENTS
Phone MUrray Hill 3-3408
FLANGED VALVES & FITTINGS

# COMPLETE POWER PLANTS

**STEAM—ELECTRIC—HYDRO—DIESEL**

***"Export Orders Carefully Executed"***

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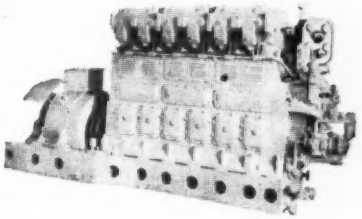

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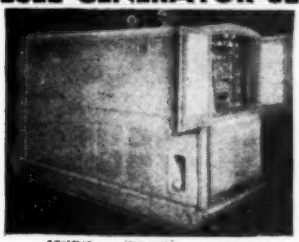

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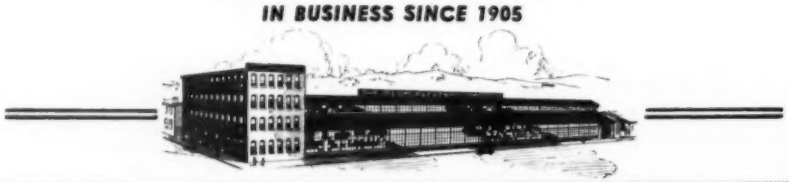

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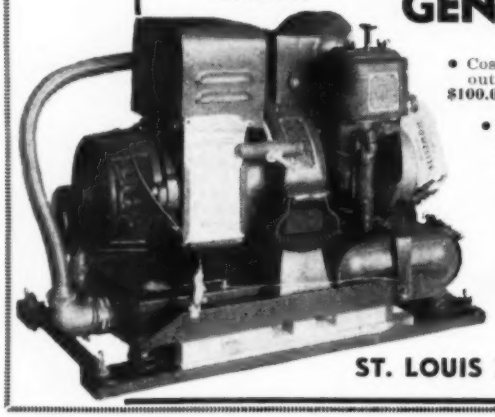

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2—200 KW, 250 volt D.C. M-G set, 2300-3-60 Ind. Motor 850 RPM complete with controls.

3—200 HP Wstg 1150 RPM motors, 230 volts D.C., Type SK.

1—110 HP Triumph motor, 290/580 RPM, 230 volts, D.C.

1—50 HP Ideal motor, 600 RPM, 2200 volts, syn.

1—125 HP Allis-Chalmers, 277 RPM, 220 volts, Syn.

1—50 HP Burke, 900 RPM, 220-3-60 Squirrel Cage.

1—100 HP, Wstg. 550 RPM, 220-3-60 Squirrel Cage.

Over 100 more D.C. motors, 1 to 100 HP 230 volt, adjustable and constant speed.

A-C SUPPLY CO.

**ELECTRIC MOTOR & REPAIR CO.**

*Division of A-C Supply Co.*

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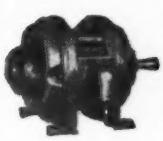
200 KVA Generator, 440 volts, 3 phase, 60 cycle direct connected to 10 KW, 125 volts, 80 amp exciter. 360 RPM. Complete with bearings and switchboard.

**THE ATLANTIC WIRE COMPANY**

BRANFORD, CONN.

# POWER EQUIPMENT COMPANY



**OIL—AIR CIRCUIT BREAKERS**

4—500 A GE FK 12 3 PST 15,000 V. Handle, Trip Coils and Currents.

1—800 A Conduit E4 600 V. 3 PST Handle, Trip Coils and Currents.

1—1200 A. GE FK 132 A 3 PST 7500 Handle with Trip Coils and Current Transformer.

1—2000 A GE CK 3 Air Breaker 3 PST 600 V. O. I. & U.V.

1—3000 A GE FK 25 Oil Breaker 3 PST 600 V. Solenoid operated with currents.

**Sq. Cage—220/440 V. 60 Cy. 3 ph.**

| Qu. | HP | Make | Type | Speed |
|---|---|---|---|---|
| 2 | 50 | G.E. | KT-327 | 1800 |
| 2 | 100 | G.E. | IK | 1800 |
| 1 | 150 | West. | CS | 1800 |

**Slip Ring—220/440 V. 60 cy. 3 ph.**

| | | | | |
|---|---|---|---|---|
| 1 | 40 | West. | CW | 720 |
| 1 | 50 | G.E. | I-M | 900 |
| 1 | 60 | G.E. | I-M | 900 |
| 1 | 75 | West. | CW | 900 |
| 1 | 250 | West. | CW | 1200 |

**D. C. Variable Speed 230 V.**

| | | | | |
|---|---|---|---|---|
| 1 | 15 | West. | SK | 400/1600 |
| 1 | 25 | West. | SK | 440/1200 |
| 1 | 50 | West. | SK | 500/1500 |
| 1 | 50 | G.E. | CD | 400/1600 |

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FOR SALE

## COAL STOKERS

One Combustion Engineering Company Type E steam-driven Stoker, 10 ft. 4 inches long by 7 feet, 6 inches wide grate. Complete with Ruggles-Kilngeman control for regulating air, fuel and furnace draft. Cast iron stoker front. Used one year. Cost new installed approximately $3200. In good condition. Available for immediate delivery. No reasonable offer will be refused. F.O.B. Cambridge, Massachusetts.

### FOR SALE

One Combustion Engineering Company Type E steam-driven Stoker, 10 feet, 4 inches long by 9 feet, 1 inch wide grate. 6-foot high stoker front. Cost new approximately $2,900. Never installed, never used. Available for immediate delivery. No reasonable offer will be refused. F.O.B. Cambridge, Massachusetts.

**SIMPLEX WIRE & CABLE CO.**
79 Sidney St., Cambridge 39, Mass.

---

## PRICED TO SELL BOILERS

**Recently Removed From Service GOOD CONDITION**

1. *800 HP STERLING WATER TUBE BOILER,* Babcock and Wilcox Co.; Class M-#26; 42" Steam Drum; 48" Mud Drum; 160 lbs. Pressure; Single Liptak Arch; Regular Trimmings.
2. *750 HP STERLING WATER TUBE BOILER,* Babcock and Wilcox Co.; Class M-#126; 3-42" Steam Drums; 48" Mud Drum; 160 lbs. Pressure; Single Liptak Arch; Regular Trimmings.
3. *500 HP BADENHAUSEN WATER TUBE BOILER;* 150 lbs. Pressure; Dutch Over Setting; 150 lbs. Pressure; Regular Trimmings.
4. *300 HP LYONS COMBINATION FIRE AND WATER TUBE BOILER;* 150 lbs. Pressure.

*Prices quoted FOB Car or Truck, Present Location*

*Available for immediate delivery.* *Subject to prior sale.*

DULIEN STEEL PRODUCTS, INC.
OF WASHINGTON
1008 WESTERN AVE. SEATTLE 4, WASH.

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1—Westinghouse Alternating Current Generator, 250 K.W., 220 volts, 568 amps per terminal, 3 phase, 60 cycles, 257 R.P.Ms.

1—Pettibone Coal Pulverizer, manufactured by the Simms Company, Erie, Pennsylvania.

Pettibone Unit, size G2, capacity one ton per hour, driven by 30 h/p induction motor, 230 volts, 71.5 amps per terminal, 60 cycles, 3 phase, 750 R.P.Ms.

1—Dongo Magnetic Separator, 110 volts, high intensity, type 12SM, all required electrical control, manufactured by the Dongo Magnetic Seperator Company, Milwaukee, Wisconsin.

1—Williams Patent Crusher, manufactured by the Williams Patent Crusher & Pulverizing Company, St. Louis, Missouri. Powered with a 7.5 h/p motor, 3 phase, 223-240 volts, 60 cycles, type CS, class 1, frame 284, with all required electrical controls.

1—G.E. Induction Motor. Type KT-326-6-30-1200, form B, model 97, volts 220, amps 73, phase 3, cycles 60, h/p 30, R.P.M. 1150, full load #4154403.

1—General Electric Co. Starting Compensator, N.R. 5025-R.I.-3233 volts, Pri. 220, Sec. 88-187, for 30 h/p motor, 60 cycles, 3 phase.

1—General Electric Co. Starting Compensator N.R. 5006, R.I. 3233 volts, Pri. 220, Sec. 110-176, for 7½ h/p motor, 60 cycles, 3 phase.

**GENERAL INSTITUTE OF CHILD HYGIENE**
79-55 Albion St., Elmhurst, New York City

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### 2-150 H.P. 230 Volt

## VARIABLE SPEED MOTORS

Electro-Dynamic variable speed motors, 3 bearing type mounted on a factory CI base, 230 volt DC 250/500 RPM, compound wound interpole. These maintain their rated horsepower at 200 to 800 RPM complete with monitor automatic control panels.

***Send us your inquires!***

**THE MOTOR POWER CO. OF NEW YORK, INC.**
859 Madison Avenue, New York 21, N. Y.
RHinelander 4-6478

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FOR SALE

## 1—Kroeschel 500 H.P. Sterling type four drum water tube boiler

Complete with all usual fittings including Copes feed water regulator and 8" Edwards Non-Return Valve. Boiler built for 200 P.S.I. and installed in 1935. It is equipped with 3 Hoffman Firite Stokers complete with motor drive. Forced draft fan direct connected to a 10 H.P. 1160 R.P.M. 220-volt, 3 phase 60 cycle motor. Complete coal handling equipment including coal bins of about 175 tons capacity.

**All the above equipment is in first class operating condition and can be seen in our plant until approximately June 1, 1946, when it will be replaced by a larger boiler. We will be glad to furnish any further information on request.**

**PFEIFFER BREWING CO. 3740 Bellevue Ave. Detroit 7, Mich.**

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FOR SALE

## STOKERS

2—Riley Jones, underfeed stokers, hydraulic drive, ram feed. All electric automatic controls. Complete with cast iron front plate doors, dump type grate, 6' wide by 6' deep. Used 2 years in Keeler 150 HP HRT boilers.

## SILO

Beaumont Birch 75-ton sectional concrete silo with electrically driven vertical loader and screw conveyor between silo and stoker hopper. Will sell all or any part at great discount from original price.

**FRANK MERCANTILE CO.**
183 Madison Ave., New York, N. Y.

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## BOILERS

2—SPRINGFIELD sectional steel header cross drum water tube boilers arranged for oil burning 400 H.P. (each) NEW JERSEY & ASME Stamping.

**H. P. BREARLEY**
3423-91St. Street Jackson Heights, N. Y.

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23" Leffel, 16" and 12" Christiana vertical shaft turbines all with Woodward governors. Shaft, yoke, gears, 6' pulley and belt for 23" wheel.
General Electric 50 KW 120 Amp 250 V 1200 rpm PF I Type ATB Generator.

**EDWARD K. BRYANT**
Sykesville Rd., Wrightstown, N. J.

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FOR IMMEDIATE SALE

**Good steam and refrigerating plant equipment, New England**

1—IR, ERI Air Compressor 10" & 14" x 12".
1—DLV 18" x 24" Hor. Ammonia Compressor—200 tons capacity direct connected Ames Unaflow.
2—C.H. Wh. 3'x9' Surface Steam Condensers 682⅝" tubes with Rotrex Vacuum Pumps & motors.
1—Knowles hor. Simplex 4½"x5"x6" hot well pump.
1—Terry-Penn Turb. dr.-Cent. Pump, 80' hd.
1—Penn Centrifugal 1000 GPM—85' head, direct conn. 30 HP Cr.-Wh. 115 Volt D.C. mtr.
1—Wr. Austin Co. oil separator 26" inlet & outlet.
1—Harrison Safety Boiler Works Coch. open heater, V notch recording, 40,000 lbs. per hr. cap.
1—Ames hor. Unaflow Crocker Wheeler D.C., 115 Volt generator 50 KW—275 RPM.
1—30 KW Harr.—325 RPM. 230 V. D.C., gen. set.
1—15 HP Cr. Wh. D.C. motor 115 V, 800 RPM.
1—80 HP Cr. Wh. D.C. motor 115 V, 1200 RPM.
1—2 HP Cr. Wh. D.C. motor 115 V, 1550 RPM.
1—5 HP Cr. Wh. D.C. motor 115 V, 1200 RPM.
1—60 HP Cr. Wh. D.C. mtr. 115 V, 300 RPM dble.

FS-130, Power, 330 W. 42nd St., N. Y. 18, N. Y.

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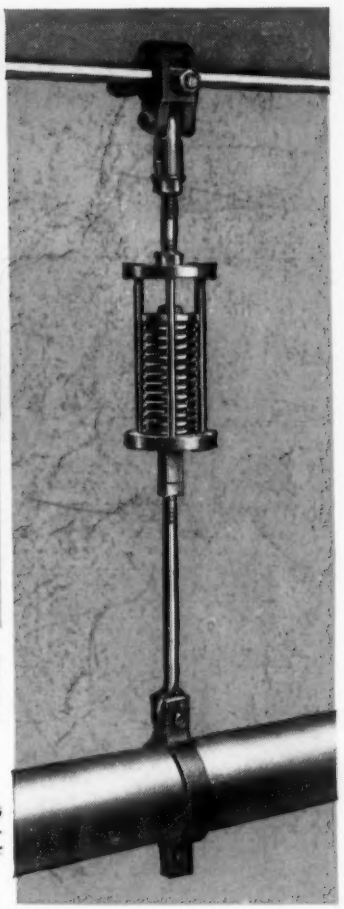

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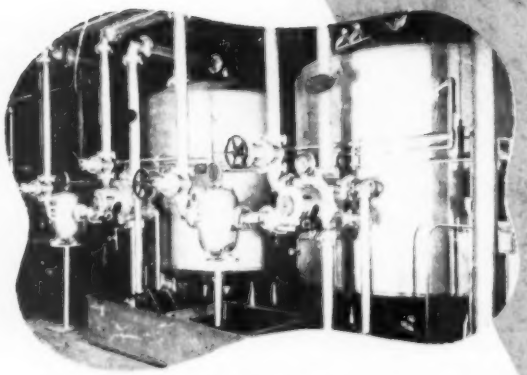

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